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AGRICULTURAL CLIMATOLOGY, PHYSICAL BELTS, AND CROP ECOLOGY OF PALESTINE AND TRANS-JORDAN AND THEIR CLIMATIC ANALOGUES IN THE UNITED STATES

by

M.Y. NUTTONSON

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Mr. Nuttonson is Senior Agronomist in the Technical Collaboration Branch of the Office of Foreign Agricultural Relations.

UNITED STATES DEPARTMENT OF AGRICULTURE

Office of Foreign Agricultural Relations

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INTRODUCTION

This study of Palestine and Trans-Jordan is one of a number dealing with North American agro-climatic analogues for the various countries of the world. The purpose of these studies is to formulate and to facilitate an agronomic and horticultural ecological approach to the problem of plant introduction and the exchange of plant material.

From a purely regional point of view, there is often a need for crop diversification and improvement, as well as a need for economy in time, effort, and cost of the carefully conducted varietal field trials of newly introduced varieties of various plant species. A less empirical attitude toward selection of plant-source areas for the region in question, as well as a less arbitrary attitude toward the selection of areas of field trials for a given plant material of a definite agro-climatic origin, may facilitate such saving of time and effort.

It is fully appreciated that the elasticity of adaptation of a given plant variety is in no way limited or predetermined by the agro-climatic or the general ecological characteristic of its place of origin or discovery. It is also appreciated that often completely different and new environmental conditions may permit a variety to perform better, or worse, or just as well as, in its original environment and that this has tobe ascertained by empirical trials. Moreover, there is the fullest appreciation of the fact that, although the climatic and latitudinal environments, which are utilized as the bases in these comparative studies, are among the most potent factors of plant adaptation for many a variety of different crop species, there are also a number of other specific ecological factors in various areas which are of great importance in plant adaptation and which do not lend themselves to any mathematical expressions and comparisons. The feeling is, however, that where a purely regional point of view prevails and where results are needed and the economical considerations of securing such results are of considerable importance, an orientation on the agro-climatic origin of the plant variety may be desirable.

In dealing with varieties of crop species, the adaptation of which in terms of their geographical climatic distribution and phenological behavior is fairly well known, it was deemed possible to approach the agronomic and horticultural problem of plant introduction and exchange of plant material through a comparative study of the agro-climatic characteristics of the various crop regions of the countries under consideration.

OBJECTIVE AND METHOD OF PROCEDURE

The objective of this study is to organize, define, and analyze the various distinct agro-climatic conditions prevailing in the different parts of Palestine and Trans-Jordan and to compare them with various agro-climatic regions of the United

States in order to ascertain "climatic analogues." These "climatic analogues" are areas in the United States and the other countries that are enough alike with respect to some of the major weather characteristics affecting crop production, particularly during the growing period, to offer a fairly good chance for the success of plant material transplanted from one area to its climatic counterpart.

Meteorological data of all available weather stations of the Palestine-Trans-Jordan territory and those of the United States have been utilized as the main source of material for this study. The crops grown, the crop geography, and the physiographic and soil characteristics of the various physical belts of Palestine and Trans-Jordan have also been considered and presented.

The elements of comparison used in this study are mean monthly and yearly temperatures, average monthly, seasonal, and yearly precipitation, precipitation-effectivity indexes and ratios (Thornthwaite's method), relative humidity of the atmosphere, and latitudes.

Climatic analogues were formulated on the basis of the comparison of the above-mentioned elements. After such elements of the environment of a given Palestine or Trans-Jordan meteorological station had been computed and studied, a search was made among United States stations for a similar climatic and latitudinal environment. The environment of the United States area found to resemble most nearly that of the station under consideration in Palestine or Trans-Jordan was recorded as climatically analogous to it. A complete list of such partially climatically analogous United States meteorological stations and their locations, as well as some of the points in which they differ from their respective "opposite number" in Palestine or Trans-Jordan, is given in the two agro-climatic charts of this paper.

In addition to the climatic analogues based upon similarities in the precipitation pattern and as many of the elements of comparison as possible, another comparative study without regard to the precipitation pattern and based mainly on the temperature and relative-humidity similarities was also undertaken in order to ascertain additional, or more exact, climatic analogues for irrigated crops. A list of such additional thermal analogues is found in each of the two agro-climatic charts of this paper.

A map of Palestine and Trans-Jordan, showing the altitudes of these two countries and the location of their meteorological stations, as well as the names of States and counties of the location of their United States climatic counterparts, is also presented with this paper.

A further check of a number of established climatic analogues has been made possible through a comparative study of phenological data of a number of varieties of a few crop species grown in climatically and latitudinally fairly analogous areas of the United States and Palestine. These phenological comparisons, as well as some comparative studies of the summation of the accumulated day-degrees required to bring a crop to a definite phenological stage, or to maturity, are to be made available in considerable detail in another paper.

GENERAL AND COMPARATIVE GEOGRAPHY

An elongated and narrow country, lying on the eastern shore of the Mediterranean Sea, Palestine is a land of sharp contrasts. Arid wilderness and tilled field; treeless, overgrazed, and eroded hills and carefully managed soils and plantings are features of the country, one of the oldest in the world. It is bounded on the north by the mountains of Lebanon and by Syria, on the east by Trans-Jordan, on the south by the desert of the Sinai Province of Egypt, and on the west by the Mediterranean Sea.

Trans-Jordan - largely a pastoral elevated plateau of a more arid climate and a relatively greater number of perennial springs and streams - lies east of Palestine and stretches from the Yarmuk River in the north to the Gulf of Aqaba in the south. It is bounded on the north by Syria, on the northeast by Iraq, on the southeast and south by Saudi Arabia, and on the west by Palestine.

Palestine occupies the southwestern edge of Asia, forming the only land junction between the Continents of Asia and Africa, and lies between latitudes 29°30' and 33°17' N. and between longitudes 34°13' and 35°42' E. Trans-Jordan lies between latitudes 29°20' and 33°25' N. and between longitudes 35° and 39° E.

If the latitudes of the two countries were superimposed upon the map of North America, one would find that their northern extremities lie in the same latitude as do a number of areas of southern California, southern Arizona, southern New Mexico, northern Texas, and southern Arkansas, as well as a number of areas of the central parts of the States of Mississippi, Alabama, and South Carolina. Similarly, the latitudes of the southern extremities of Palestine and Trans-Jordan run through central parts of Lower California, northern Mexico, southern Texas, southern Louisiana, and the southern part of northern Florida.

A study of the climate of Palestine and Trans-Jordan in terms of North American regions located within similar precipitation-effectivity indexes, and within similar precipitation-distribution patterns and thermal conditions, suggests mainly certain areas of southern California. In a few instances, however, when only the temperature and relative-humidity data of a number of meteorological stations of Palestine and Trans-Jordan are considered, they seem to resemble more nearly the conditions prevailing either in certain areas of southern Texas, or in certain areas of southern Arizona, and occasionally suggest even those of certain areas of southern Florida.

The total area of present-day Palestine is about 10,430 square miles, which is about one-fifteenth of the area of the State of California. The area of Palestine could be described, however, as nearly equal to that of the coastal strip of California south of the Tehachapi Range, consisting of part of Santa Barbara County, all of Ventura, Los Angeles, and Orange Counties, and portions of San Bernardino, Riverside, and San Diego Counties which lie west of the mountains. The approximate area of Trans-Jordan is estimated to be about 34,700 square miles, which is somewhat more than three times that of the area of Palestine.

In its general physical aspects, Palestine, with its diversified topography and its variety of climate; with its coastal plains, uplands, deep depressions, barren hills, and fertile valleys; with its land area between the desert on the east and the sea on the west; and with its warm, wet winters and hot, dry summers, is not unlike a considerable number of areas of the State of California. The sea breezes and desert winds of Palestine, its semidesert terrain, its blue sky and maximum sunshine prevailing most of the year, its semiarid climatic conditions, its native chaparral and cultivated crops, its man-made changes in the agricultural ecological conditions - all find their counterparts in California. Within certain limitations, the general physical aspects of Trans-Jordan are not unlike those of certain areas of Palestine and thus suggest also a certain resemblance to some areas of California. Trans-Jordan, however, is farther from the sea and nearer to the desert than is Palestine. Both the terrain and the climate of Trans-Jordan are altogether harsher and more arid and therefore suggest only some of the more inland and more arid areas of southern California.

TOPOGRAPHIC PATTERN AND PHYSICAL BELTS OF PALESTINE AND TRANS-JORDAN

Topographically, the land area of Palestine, north of the semidesert southern half of the country known as the Negeb, can be divided into three north-south natural belts. These constitute the main relief features of the economically important part of Palestine and consist of the maritime or coastal-plain belt, the upland or the mountain belt, and the Jordan depression with its Araba extension. The Negeb half of Palestine - the fourth physical belt of the country - forms a large triangle with its apex at the Gulf of Aqaba and does not represent a uniform topographic pattern of its own.

1. The Maritime Plain - an undulating coastal lowland dotted with sandstone (Kurkar) hills. This coastal plain runs from the Negeb in the south all the way to the north and is bounded by the Mediterranean Sea on the west and by low hills and mountains on the east. On the west, alongside the sea, the coastal plain is fringed by sand dunes practically throughout its whole extent. The total area of the plain covers about 1,200 square miles, its total length is almost 120 miles, its width mostly increases southward and varies from a few yards to 20 miles, and its highest elevation does not exceed 660 feet above sea level. From Tel Aviv for about 50 miles north - to the area where the spurs of Mount Carmel begin, just south of Haifa - the coastal plain is referred to as the Plain of Sharon; from Lydda south for about 60 miles it is known as the ancient Plain of the Philistines, or the Plain of Judea. From Mount Carmel all the way to its northern end, the coastal plain is referred to as the Plain of Acre. The coastal area between Mount Carmel and Acre is also known as Emek Zevulum. In its climate, soil, and vegetation, the coastal plain differs from the other belts of the country. South of the Plain of the Philistines, the coastal-plain belt ends, and the plain of the Negeb begins.

2. The Uplands, or the Hill Country, of Palestine - a series of hills and mountains east of the coastal plain traversed by streams and dotted with plains in a number of places. From the Lebanon Mountains in the north to the Sinai Peninsula in the south, these dissected highlands of Palestine rise gradually in fairly gentle slopes from the western coastal plain to an elevated table and then drop abruptly on the east into the lowest inland depression on earth, known as the Jordan Rift or the Gohr. The upland belt only occasionally attains an elevation above 3,000 feet and varies in width from 25 miles in the north to 40 miles in the south. It is slightly more than 3,700 square miles in area, or more than a third as large as the entire country. The uplands are divided into two distinct blocks by the broad lowland passage of the Plain of Esdraelon and its eastern extension, the Valley of Jezreel. This lowland passage, roughly triangular in shape and known as the Emek, cuts across the mountain system from west to east and connects the coastal plain with the Jordan Rift. The combined land area of the Plain of Esdraelon and the Valley of Jezreel is about 190 square miles; the total greatest length and width of this are 30 and 12 miles, respectively. The upland block to the north of this lowland passage consists of the rolling hill country of Upper and Lower Galilee, which occupies a total land area of about 800 square miles; the block to the south comprises the highlands of Samaria and Judea and covers a total area of 2,900 square miles. Upper and Lower Galilee are separated by the Plain of Asochis, which is 9 miles long from east to west, 2 miles wide, and about 500 feet above sea level. Upper Galilee is a mountainous plateau, about 16 miles from north to south and 25 miles from east to west, the highest point of which rises to 3,963 feet above sea level. Lower Galilee consists of several parallel ridges, which run from east to west with open valleys between them, and, com-

pared with Upper Galilee, it has less regular features and a lower altitude. It does not rise more than 2,000 feet above sea level, is not more than 28 miles long from east to west, and is not more than 7 miles from north to south. Samaria is mountainous throughout but is interspersed with a number of small plains and open valleys. It is about 50 miles long from north to south, 30 miles wide from east to west, and covers an area of about 1,600 square miles. Its highest point is 3,290 feet above sea level, and the rounded slopes of its mountains contrast sharply with the much more rugged appearance of the Judean Plateau to the south. Judea is less dissected than Samaria and becomes harsher and more rugged in landscape toward the south. From north to south this plateau is about 48 miles in length, from west to east it widens gradually from 15 miles in the north to 25 miles in the south, and its highest point is 3,336 feet above sea level.

The Judean and Samarian highlands, as already mentioned, slope very steeply to the east but very gradually to the west. Actually, the descent on the west is in two steps: To the Shephelah Plateau, and then to the coastal plain. The Shephelah represents a range of low hills lying between the southern part of the coastal plain and the highlands and separated from the main slopes of Judea and Samaria by a small elevated plain. The Shephelah stretches for 30 miles from Samaria southward to near Gaza and is from 5 to 8 miles wide. Its elevation is on the average below 800 feet, and its highest point reaches to 1,500 feet above sea level. The Judean Plateau is separated from the Negeb region to the south by the Beersheba Valley. This valley, as well as the passage provided by the Plain of Esdraelon, and the Valley of Jezreel in the north are the two main lowland connections between the coastal plain and the Jordan Rift.

3. The Jordan Rift - a great land depression consisting of a long, straight, deep valley with very steep sides. The valley represents an area of about 240 square miles and averages in width from less than 3 to more than 14 miles. It is drained by the Jordan River - the largest and principal river of Palestine and Trans-Jordan. Its headwaters begin in the north, where the floor of the valley is about 492 feet above sea level, and flow through the Huleh Plain - about 72 square miles in area - to form Lake Hule (Waters of Meirom). Ten miles to the south, where the Jordan flows through the Sea of Galilee, the valley is nearly 700 feet below sea level, and as the river ends its course at the Dead Sea the floor of the valley is about 1,280 feet below sea level. On the basis of elevation and relative aridity, the Jordan Valley is subdivided into three natural regions: Upper or northern region, central region, and the lower or southern region. The Jordan River flows through the center of the valley and separates the uplands of Palestine to the west from the uplands of Trans-Jordan to the east, as well as the western Palestine half of the valley from the eastern half which is generally in Trans-Jordan territory. South of the Dead Sea the depression continues and is known as the Plain of Araba, which extends all the way down south to the Bay of Aqaba. The surface of the Plain of Araba is flat, with occasional mounds, and its area is slightly more than 300 square miles.

4. The southern half of Palestine known as the Negeb, referred to previously, represents a southern continuation of the Judean Plateau and the Shephelah but overrides the surface configuration characteristics of the distinct topographical belts to the north. It consists of a triangular land area intersected by dry valleys (wadis) and covers about 4,700 square miles, an area nearly as large as that of the rest of Palestine. The Negeb can be subdivided into the following four districts: (a) An undulating, rectangular-shaped coastal plain occupying nearly 350 square miles; (b) an upland plateau reaching up to 1,650 feet above sea level and occupying about

1,300 square miles; (c) an unexplored mountain area, triangular in shape, and occupying more than 2,600 square miles; and (d) a desert area of nearly 300 square miles.

The Trans-Jordan uplands east of the Jordan Valley also represent a north-south strip of land running parallel to the above-described three topographical belts of Palestine. It can thus be looked upon as constituting the fourth north-south topographical belt of the combined land mass of Palestine and Trans-Jordan.

As a whole, the physiography of Trans-Jordan is more uniform in character than that of Palestine and consists of three main regions running in a north-south direction. From west to east these are as follows:

1. The Jordan Rift - the eastern half of the Jordan Valley, which represents the westernmost frontier of Trans-Jordan and covers an area of slightly more than 210 square miles.

2. The Highlands of Trans-Jordan to the east of the valley - a north-to-south succession of a series of high, discontinuous, ravine-broken, wide mountain blocks and rolling plateaus of varying widths, with a steep fall to the west, that is, to the Jordan depression. This region stretches south down to latitude 30° N., and its plateaus rise to over 4,000 feet above sea level in the north and over 5,400 feet in the south. A southern section of the Huran Plain and the ancient lands of Golan, Gelad, Amman, Moab, and Edom lie within this region of about 4,600 square miles in area. While the western escarpments of these highlands are steep, they slope gently toward the east and gradually merge into the desert region of Trans-Jordan.

3. The Desert of Trans-Jordan - an undulating arid region to the east of the highlands of Trans-Jordan. This zone occupies more than four-fifths of the area of the whole country and covers its entire eastern part, except for the few oases and water points. The average elevation of this region is over 1,650 feet above sea level, but in some areas it reaches a height of more than 3,000 feet.

South of the highland region of Trans-Jordan; that is, south of parallel 30° N. latitude and all the way down to the Gulf of Aqaba, extends a climatically distinct region of sands, which is referred to as El Hasma.

CLIMATE OF PALESTINE AND TRANS-JORDAN AND UNITED STATES CLIMATIC ANALOGUES

Most of Palestine and Trans-Jordan are subject to semiarid, as well as to arid, subtropical climatic conditions. Meteorological data covering long periods of time are not available for the greater part of Trans-Jordan, nor are such data available for quite a number of areas of Palestine. The meager and fragmentary meteorological data of Trans-Jordan, however, as well as the much more extensive and complete data of Palestine, suggest a considerable diversity of climatic conditions within the various physical regions of the two countries. These data are presented in the two agro-climatic charts of this paper.

In spite of the great local climatic variations of Palestine and Trans-Jordan, some of the major climatic features suggest a certain essential unity in the character of the climate of the two countries. The occurrence of two sharply divided and well-marked seasons, namely, a rainy, mild winter and a dry, hot summer; the virtually absent, or very short, periods of transition from winter to summer and summer to winter, with no regular sequence of weather during these transitional periods; the great amount of sunshine and the bright cloudless skies throughout most of the long summer season; the hot, dry desert winds during the spring and fall months - are all common climatic characteristics of most of the regions of Palestine and Trans-Jordan, as well as of a number of regions in the State of California.

Palestine lies in the transitional region between the Mediterranean area that is comparatively well supplied with moisture and the deserts of Asia and Africa. It is subject to the influence of both sea breezes and the desert winds, and its climate is transitory between the Mediterranean and the desert type. In summer the sea breezes exert a cooling, moderating effect on the temperature and raise the humidity, whereas in winter they exert a warming effect and bring rain. These effects of the sea breezes are quite pronounced, especially along the coastal-plain belt and to some extent also along the western slopes of the mountain belt. Their influence is less pronounced as one proceeds east of the divide of the Palestine mountain belt; it is also less pronounced from north to south. The humidity and rainfall in Palestine decrease from north to south and from west of the divide eastward. Trans-Jordan is farther east from the sea and nearer to the desert than is Palestine and is much less subject to the sea influences. On the other hand, the whole of the two countries is more or less open to the influence of the desert. This manifests itself, for example, by the khamsin or hot sirocco desert winds. These are hot, dry, oppressive, and dust-laden winds drawn from the deserts of Arabia. They may occur in all seasons, except summer, but blow mainly from April to May and from September to November. In many of its characteristics, the khamsin is not unlike the harsh and burning-hot desert winds which occur in May and late August in the great valleys and in the southern parts of California. Another example of the manifestation of the effect of the desert is the strong, dry northeastern or eastern winter wind, which brings with it the cold and the low humidity of the desert. These winter winds, known as the cold sirocco, are distinct from the usually much weaker southeastern hot sirocco or khamsin winds of the spring and fall. The relative humidity of the air is about equally low during either of the siroccos. The hot springtime desert winds are of greatest danger to horticultural crops during their blossom-fruit-setting period and to cereal crops during heading stage and their ripening period between the end of the milky-ripe and the completion of the yellow-ripe stages. Desiccation and the abscission of blossoms and fruit set, as well as burned, empty spikelets and shriveled grain, are sometimes among the direct effects of the hot sirocco winds. The cold sirocco at sprouting time may cause desiccation of the young sprouts. It may also cause freezing of tree-plant tissues. As a whole, the influences of the desert are greater in the east and south and less in the west and north.

As may be seen from the generalizations in table 1, as well as from the detailed charts of this paper, both the temperature and the precipitation of Palestine vary greatly throughout the country. Considerably smaller variations seem to be observed within Trans-Jordan. The area of Trans-Jordan is, however, so much larger than that of Palestine and the number of its meteorological stations is so much smaller and their available data, especially of temperature records, are so much more meager and

TABLE 1. – *Comparative range of climatic conditions in Palestine and Trans-Jordan*

CLIMATIC CONDITIONS	PALESTINE	TRANS-JORDAN
Average annual precipitation . . . . inches	1 to 38	2 to 23
Precipitation-effectivity indexes	1 to 76	3 to 22
Average annual relative humidity . . . . percent	47 to 79	-
Temperature:		
Mean of coldest month . . . . degrees F. . .	43 to 61	47 to 58
Mean of warmest month . . . . do	73 to 92	80 to 87
Annual mean . . . . do	56 to 78	64 to 71
Absolute maximum . . . . do	86 to 120	109 to 113
Absolute minimum . . . . do	19 to 46	21 to 55

fragmentary that a comparison of the relative extent of climatic variations of the countries can be made only with due reservations. The number of stations in the two countries used for this study may be seen on the charts and map.

Variations in temperature, relative humidity, and precipitation of Palestine seem to be mainly related to the position of its various areas in relation to proximity and lack of physical barriers to the open sea, proximity to the desert, and altitude. The hottest month of the year is August; the coldest is January. Generally speaking, temperature ranges increase with greater distance and shelter from the sea and closer proximity to the desert; also, temperatures go down as altitude increases. The amount of precipitation within the same altitude, proximity, and accessibility to the sea is greater in the north than in the south; in the western watershed it is greater on the high ground than on the plains; and it is greater also west of the divide than farther inland within the eastern watershed. The relative humidity of the atmosphere depends largely on the wind direction, especially in the coastal belt and on the western slopes of the mountain belt. The desert sirocco winds are dry and reduce the humidity, whereas the sea breezes in summer bring dampness and dew. As may be seen from the agro-climatic chart of this paper, the annual temperatures do not increase with higher latitude. Within the coastal-plain belt, the annual temperature at Acre, in the north, is 70° F.; at Tel Aviv 69°; and at Gaza in the south 67°. Thus, actually, the annual temperature in the south is somewhat lower than in the north.

The physical structure of Palestine and Trans-Jordan has a rather pronounced bearing upon their various local and regional climates. The division of these countries into a number of physical belts corresponds also to their climatically distinct regions.

Some of the data of a few selected meteorological stations of Palestine (table 2) may illustrate in a general way the major climatic characteristics of the four belts of that country. The stations selected for the three parallel topographic belts are of about the same latitudinal position. The station of the Negeb is about 1° south of the other three stations.

TABLE 2. – *Comparative climatic conditions of the various belts of Palestine*[1]

CLIMATIC CONDITIONS	MARITIME PLAIN AT TEL AVIV	THE HILL COUNTRY AT JERUSALEM	JORDAN VALLEY AT JERICHO	NEGEB AT BEERSHEBA
Mean temperature of coldest month . . . degrees F.	55	47	57	54
Mean temperature of warmest month . . . . . do	81	75	88	80
Annual mean . . . . do	69	63	74	68
Absolute maximum temperature . . . . do	115	107	120	115
Absolute minimum temperature . . . . do	37	26	36	32
Average annual relative humidity . . . percent	79	69	54	66
Average annual precipitation . . . . . inches	20.8	15.9	5.0	7.8
Precipitation-effectivity index	36.9	34.1	7.1	13.0
Summation of degrees of daily mean temperatures above 50° F.:				
Between May 1 and October 1 . . . . . degrees F.	4,162	3,519	5,385	4,162
Between October 1 and May 1 . . . . do	2,641	1,496	3,464	2,497
Total – throughout the year . . . . do	6,803	5,015	8,851	6,659

[1] Elevation of stations: Tel Aviv, 105 ft.; Jerusalem, 2,485 ft.; Jericho, 820 ft.; and Beersheba, 938 ft. above sea level.

The data of the agro-climatic chart of this paper, as well as of table 2, indicate that the temperature is higher in the Jordan Valley than in the Maritime Plain, whereas in the latter belt it is higher than in the Hill Country; also, that in these belts the humidity, precipitation, and precipitation-effectivity indexes decrease with the distance from the sea. The precipitation and the precipitation-effectivity indexes, however, vary greatly with altitude, and, hence, the distance from the sea is not the sole factor. It may be observed also from table 2 that, while the mean and maxima temperatures of the Negeb are not too unlike those of the Maritime Plain, its minima temperatures are lower and its relative aridity is very pronounced. South of Beersheba the aridity and the width of temperature range of the Negeb belt are even more pronounced. A comparison of the meteorological data of the various physical belts of Trans-Jordan is impossible to make because of insufficient data.

The most outstanding and the ruling feature of the climate of Palestine and Trans-Jordan is the division of the year into a rainy and a dry season. The rainy season begins in October or November and ends in April. Most of the precipitation occurs during the period of November-March. October and April usually have less precipitation than the November-March period. Little precipitation, if any, occurs in May, and usually none at all from May to October, except for occasional and exceptional showers due to thunderstorms. The first rains, the main rains, and the late rains constitute the three phases of the local rainy period. The first or "former" rains take place during October and November; the main rains - a period of the greater part of the total precipitation - occur during December, January, and February; the late or "latter" rains take place during March and April. The rainfall is the heaviest usually from the middle of January to the end of February. The first rains are heaviest on the coast; the late rains are heavier than the first in the inland areas but not on the coast.

Exceptions to this rainfall distribution are not infrequent, however. During the rainy period itself, there are at times prolonged dry periods. Especially long is the interval before the late rains, and there are years when these do not occur at all. There have occurred also years in which the first rains have failed completely. On the other hand, there are years with a precipitation considerably greater than that of the normal year. The intensity of the rainfall varies greatly all the way from gentle showers to violent storms and cloudbursts causing floods and soil erosion. The irregularities in precipitation manifest themselves in the quantitative differences of the amounts of total rainfall in various years, in the dates of beginning and ending of the rainy season, and in the distribution and intensity of the rains during the season.

For places of more or less similar altitude, the amount of rainfall decreases from north to south and from west to east. As already mentioned, the average annual precipitation for Palestine as a whole ranges from 1 to 38 inches, and in Trans-Jordan from 2 to 23 inches. Where there are no high mountains to intercept the rain, or where the high mountains are far from the coast, a greater amount of precipitation penetrates farther inland than in areas where the high mountains stretch along the coast and restrict the heavier rainfall to a narrow seaboard. The Plain of Esdraelon and the Valley of Jezreel represent examples of a condition where the desert recedes relatively far eastward owing to the absence of high mountains and the consequent farther penetration of the rain from the west.

The precipitation-distribution pattern of Palestine and Trans-Jordan resembles that of the Pacific-coast area of North America. The absolute amounts of precipitation, however, in conjunction with the prevailing temperatures and the consequent precipitation-effectivity indexes and the precipitation-effectivity ratios of the rainy season, as well as latitudinal considerations, limit the resemblance mainly to the southernmost part of the United States Pacific-coast area.

Fairly satisfactory climatic analogues for most of the Palestine and Trans-Jordan meteorological stations used in this work were found to be available in the United States and have been formulated in this study. Based on analogy of precipitation distribution, precipitation-effectivity indexes, and in most but not all cases on the basis of actual temperature and relative-humidity conditions, the United States climatic analogues of Palestine and Trans-Jordan are limited mainly to the southern parts of the State of California. In a number of cases, however, the actual temperature conditions and the summations of heat units were found to correspond more nearly to those of certain areas of southern Texas and Arizona. Also, the relative-humidity data of a considerable number of Palestine meteorological stations are too high even for the southern coastal sections of California and suggest more nearly the environment of a number of areas along the coast in the lower Rio Grande Valley of Texas and in southern Florida.

The sparse observational data of the relative humidity of California, Arizona, Texas, and Florida do not permit a fuller comparative study and a more concrete utilization of the extensive relative-humidity data of Palestine. The Palestine data, however, are included in the agro-climatic chart of this paper.

For dry-farming operations, the precipitation-distribution pattern and the precipitation-effectivity indexes, as well as the actual amount of precipitation and temperature conditions, have been deemed of greatest consequence in this study of matching agro-climatic environments. Under irrigation, however, to which a great part of these semiarid countries must resort for the production of valuable horticultural and agronomic crops, a combination of temperature and relative-humidity data may make a useful tool for suggesting climatic counterparts, even though the precipitation patterns do not match. The analysis of the plant reactions caused by the various climatic influences, or by a combination of certain climatic influences, would be extremely valuable for plant-introduction purposes, but not too much has been done about it as yet. Some general impressions and surveys suggest that climatic adaptation, behavior, and responses of some varieties of horticultural and agronomic crops under irrigation conditions, as well as the occurrence and prevalence of certain plant pests and diseases, may be related to their thermal and atmospheric-humidity environment.

Two methods of approach - that of ascertaining United States analogues on the basis of similarities of precipitation patterns and temperature conditions, as well as on the basis of temperature and atmospheric humidity similarities - have been utilized in this study. United States analogues for each of the meteorological stations of Palestine and Trans-Jordan and a brief statement as to some of the points of departure of the United States climatic analogue from its counterpart have been suggested in the two agro-climatic charts of this paper.

As may be seen from these charts, most of the meteorological stations of the Plain of Judea (Plain of the Philistines), Plain of Sharon, and the Plain of Acre - all of which make up the Maritime Plain of Palestine - as well as those of Samaria and those of a part of the Plain of Esdraelon find their nearest climatic counterparts in the southern coast region of California, or more specifically in Los Angeles County. The temperatures of some of these stations and their total heat-summation units, however, are too high for the coastal section of southern California and suggest more nearly a number of points in certain counties of southeastern California, southwestern Texas, and southern Arizona. Similarly, most of the meteorological stations of south Palestine, those of the Deep South of Palestine known as the Negeb, and those of the Jordan Valley and of the Trans-Jordan plateau, as well as a few stations of Judea, Lower Galilee, and the Valley of Jezreel, find their climatic counterparts in the southeastern area of southern California; namely, in the San Bernardino, Riverside, and Imperial Counties. A number of these meteorological stations, however, are subject to a warmer thermal environment suggesting more nearly that of Pima County in southern Arizona. There are also a few meteorological stations of Upper Galilee and the mountains of Judea which find their approximate climatic analogues in northeastern California in the counties of Yolo, Yuba, Butte, and Shasta.

COMPARATIVE PLANT-CROP ECOLOGY OF THE PHYSICAL BELTS OF PALESTINE AND TRANS-JORDAN

The major physical belts of Palestine and Trans-Jordan differ from each other not only in topography but also in climate. The climatic conditions of each belt as a whole are rather distinct from those of the other belts. However, various climatic factors are not uniform within each of the belts and permit their further subdivision into a number of climatic areas. The variations in topography and climate are accompanied by considerable diversity of soils and crops. A short outline dealing with some of the ecological conditions of these various belts and their crop adaptation and distribution may prove of interest.

The cultivated crops of Palestine and Trans-Jordan are produced either under dry-farming or irrigation conditions. Sufficient moisture, or the lack of it, is the major controlling factor in crop production of these countries. Where adequate irrigation water is available to supplement the scant natural precipitation of the semiarid or arid areas of these countries, intensive agricultural-crop production is possible. In many of the arid areas of these countries, the rainfall is frequently insufficient or too poorly distributed to permit a satisfactory production of crops even under alternate-cropping, bare-fallow, dry-farming methods.

The line of demarcation between some of the crops produced without irrigation and some of those produced with irrigation is not always definite. The same crops can be produced in either way, depending on the climatic and soil environment of the region and its irrigation facilities, the season of the year, the utilization of the crop, etc. The availability of water for irrigation, or its scarcity, is among the most potent factors which mold the nature and character of the agricultural possibilities and enterprises of these summer-dry countries. Water for irrigation, if available, is mainly obtained by means of centrifugal and turbine pumps, which are installed in wells ranging from approximately 25 to 300 feet in depth. The water is lifted to the surface and utilized for irrigation purposes. The crops which are produced mainly without irrigation, that is, under dry-farming conditions, include the various winter- and summer-grain crops, olives, grapes, almonds, and some other deciduous fruits. The principal irrigated crops include citrus fruits and bananas, as well as most of the other tropical and subtropical fruits of the country, the vegetables, and the forage crops.

Temperature and soil conditions are the main factors which determine the type of farming under irrigation conditions. Of great agricultural importance is the occurrence in the deep light soils of the coastal-plain belt of an impermeable sandy-clay substratum, known as "sakye," which forms the floor of the underground water flowing to the sea. The moderate depth of this floor permits fairly economical lifting of the underground water for irrigation purposes. In addition to underground sources, water from the rainfall run-off, the rivers, the smaller streams, and the springs are also utilized for irrigation purposes.

Description of Plant Crops

Palestine's main crops are wheat, barley, durra (a sorghum-grain species), sesame, olives, citrus fruits, grapes, and figs. With the exception of citrus fruits and olives, these are also the leading crops of Trans-Jordan. Production of vegetable, legume, and fodder crops in Palestine is of considerable magnitude, too. Lentils, beans, and peas are among the most important seed legumes, whereas berseem clover, alfalfa, and a number of vetches are among the major leguminous hay crops grown in the country. In addition to durra and sesame, the summer field crops of Palestine also include corn, cowpeas, sunflowers, and peanuts. In addition to the native hard durum wheat, a large number of varieties of which constitute the most important winter field crop of the country grown under dry-farming conditions, the main winter cereals of Palestine are several introduced varieties of soft wheat and various local varieties of barley. Tomatoes represent the most widely grown vegetable crop of the country. Eggplants, Irish potatoes, onions, peppers, cabbage, cauliflower, lettuce, carrots, horse-radish, turnips, radishes, spinach, artichokes, asparagus, garden peas, beans, cucumbers, melons, watermelons, etc., are among the many diverse vegetable crops produced in the country. Both true and rough tobacco are also grown in Palestine.

The olive tree is the most important oil plant of the country. In recent years the production of deciduous Temperate Zone fruits, such as apples, pears, Japanese plums, and peaches, has increased in Palestine, whereas almonds and apricots have already been grown there for quite some time. The banana, date palm, mango, guava, avocado, papaya, cherimoya, Japanese persimmon, and, to some extent, the pineapple seem to be among the many relatively new introductions of tropical and subtropical fruits which have commercial possibilities in certain areas of Palestine.

As a whole, the subtropical fruits are better adapted to the country and have a wider distribution there than the tropical fruits. There are some limited areas in the coastal plains and in the Valley of Jordan, however, where under proper environmental conditions the tropical plants do fairly well and lend themselves to commercial production. A considerable number of species of the deciduous Temperate Zone fruits are not very well adapted to the warm winters of the greater part of Palestine and do best under the cooler winter conditions of the higher elevations of the mountain belts of Palestine and Trans-Jordan. The major citrus culture of Palestine is the orange, of which the true Jaffa or Shamooti constitutes the best and most widely grown variety. The Washington Navel and the Late Valencia are also grown to some extent. Among the other important citrus fruits grown in Palestine is the Marsh Seedless grapefruit. A number of lemon varieties, including the Eureka variety, are also produced in the country. Among the other citrus species of minor importance grown in the country are tangerines, citrons, etc.

Agro-Climatic Conditions of the Various Areas

The coastal plain of Palestine is subject to a rather narrow daily and annual range of temperature and to a high relative humidity typical of a distinctly maritime type of climate. The summers are warm and the winters mild. The relative humidity is fairly high most of the year, except for the few days during which the sirocco winds blow from the desert. The amount of dew is large, since it falls throughout much of the year. As one proceeds eastward to the other belts, the daily temperature range becomes wider, the relative humidity lower, and the climate becomes more continental in character. Within each of these belts the aridity increases as one proceeds southward.

As a whole, in comparison with the coastal belt, the mountain belt is subject to cooler and drier summers, colder winters, and a wider daily and annual range of temperature. Climatic conditions are, however, far from being uniform throughout the mountain belt. In addition to the climatic differences within this belt due to altitude and the progressively greater aridity southward, there is also the pronounced climatic difference between the western and eastern watersheds. The western slopes are open to the sea influences, whereas the eastern slopes are isolated from those influences and, facing the desert, they are subject to semiarid conditions. The amount of precipitation on the western slopes is much higher than on the eastern slopes. From an average of 20 inches to a maximum of more than 30 inches of rainfall on the western slope, the precipitation drops to as little as 4 inches per year in certain areas of the eastern slope.

Generally speaking, the coastal-plain belt, the Plain of Esdraelon, and the western slopes of the mountain belt of Palestine, as well as a few areas of the highland region of Trans-Jordan, are subject to winters that are mild and fairly moist and summers that are hot and dry. The precipitation and temperature conditions of those areas permit a fairly satisfactory dry-farming production of winter and summer field crops. It also permits the growth of certain fruits, such as the olive, almond, European grape, carob, etc., without irrigation and permits the existence of natural and man-planted forests. The major climatic difference between the coastal plain and the western slopes of the mountain belt of Palestine is the lower winter temperature of the mountain belt. In the areas of Trans-Jordan where a relatively satisfactory dry-farming production of field crops is possible, temperatures are more extreme than in the corresponding dry-farming areas of Palestine.

The Jordan Valley is characterized by warm winters of scant precipitation and very hot and dry summers, as well as by a relatively large number of very dry sirocco days and a large daily and annual range of temperature. Here, too, precipitation increases with the increase of altitude and latitude - both of which proceed rather simultaneously in this belt.

Climatically, the combined land area of the Plain of Esdraelon and the Valley of Jezreel consists of two parts. The western part of that land area is subject to the sea influences and resembles in its temperatures and precipitation the climate of the coastal plains. The eastern part of that land area, however, is subject to progressively higher temperatures and lower precipitation as it approaches the Jordan Valley and its climatic influences. The total heat-summation averages for the May-October period (computed above 50° F.) are about 2,000° higher for the Jordan Valley than for the coastal-plain belt, and a somewhat similar thermal difference seems to exist between the westernmost and easternmost parts of the combined land area of the Plain of Esdraelon and the Valley of Jezreel.

The outstanding characteristic of the climate of the Negeb as a whole is its aridity. It is subject to hot summers and relatively cold, dry winters. While the mean and maxima temperatures and the relative humidity are not unlike those of certain areas of the coastal plains, the rainfall of the Negeb is very meager although somewhat higher in the northern portion. The daily and annual temperature range of the Negeb is wider than in the coastal plain. The moisture from the total yearly amount of dew in the Negeb is claimed to be greater than that obtained from the annual rainfall. It is likewise claimed that great benefits are derived from the dew for field crops under dry-farming conditions.

The eastern slopes of the mountain belt of Palestine, the northern part of the Negeb area of Palestine, the southern part of the upper region of the Jordan Valley, and large areas of Trans-Jordan are subject to a semiarid type of climate characterized by a less stable and considerably smaller amount of precipitation, shorter rainy season, and hotter summers and colder winters. The natural climatic conditions of this area permit dry farming of a rather unstable character. No fruit-tree culture is possible in this area without irrigation, and no natural forests occur here. In place of forests, the natural vegetation consists of sparse short grass and shrubs. The semiarid or semidesert eastern slopes of the mountain belt of Palestine, isolated from the influences of the sea by the mountain divide and open to those of the desert, include the areas known as the wilderness of Judea and Samaria.

The southern Negeb, the southern or lower region of the Jordan Valley, the Araba region, and the southern and eastern parts of Trans-Jordan are subject to an arid desert climate. The irregular and scanty precipitation of these desert areas does not permit any dry farming at all, except in the highly water-retentive loess-soil areas. As a whole, agricultural production in the desert areas is possible only with irrigation, and a number of oases that are well-supplied with water are intensively cultivated. In any irrigated spot, the vegetation is vigorous and luxurious, but the surrounding unirrigated areas are desolate and bare of vegetation.

Of all the climatic factors, the amount of precipitation and its regularity seem to be the most decisive in determining the agricultural possibilities of the dry-farming areas of the country. Along the coastal plain, the precipitation increases from 13 inches at Gaza in the south to 24 inches at Haifa in the north. A northward increase in precipitation may also be observed in the mountain belt, where precipitation increases from 16 inches at Jerusalem to 27 inches at Nazareth and 36 inches at Safad. A similar trend is found also in the Jordan Valley, where the increase in precipitation ranges from 5 inches at Jericho to 20 inches at Tiberias, and the Negeb with its approximate 1 inch of precipitation at Sodom and 8 inches at Beersheba.

Averages of the precipitation data available for the various distinct areas of Palestine are as follows:

Region	*Inches*
Coastal Belt:	
1. South	17.4
2. Plain of Judea	20.7
3. Plain of Sharon	21.3
4. Plain of Acre	27.2
Plain of Esdraelon and Valley of Jezreel	19.9
Hill Country:	
1. Judea	21.4
2. Samaria	22.7
3. Lower Galilee	25.4
4. Upper Galilee	26.8
Valley of Jordan	13.4
Negeb	5.3

The above-given averages, however, are only rough suggestions as to the relative annual amounts of precipitation for the various areas of Palestine. Actually, there are considerable variations in the amount of rainfall even within each of these areas. In addition to the quantity of precipitation, its distribution, and its regularity, the intensity of precipitation is also of considerable agro-ecological consequence, especially under certain topographical and physical soil conditions of a number of areas of Palestine and Trans-Jordan. Much of the rainfall occurs as heavy downpours of great intensity, which cause considerable water run-off and soil erosion of the mountain slopes and floods in the plains and valleys. The fluctuation in regularity of precipitation is especially pronounced in the more arid regions of the two countries, which accounts for the unstable dry-farming agriculture in the northern Negeb and in a great number of areas in Trans-Jordan.

The Trans-Jordan plateau does not provide sufficient meteorological data to permit a closer comparative study of the diversity of its climatic conditions. As a whole, however, it is subject to a drier and more continental climate than is Palestine, with a consequent lower humidity, more frequent frosts, and greater extremes of temperature. The plateau becomes more arid as one proceeds either to the east or to the south. Thus, the mountainous area of Gilead enjoys a sufficient amount of precipitation to permit a type of agriculture not unlike that of the western slopes of the mountain belt of Palestine with its relatively more stable dry-farming crop production. Winter and summer field crops, as well as such cultures as olives, grapes, and a number of various deciduous fruits, are produced in the area under dry-farming conditions. The regions of Amman, Moab, and northern Edom, however, are subject to less precipitation; and, while fairly satisfactory dry-farming production of field crops seems to be possible, no fruits are produced under dry farming. The eastern semidesert area of Trans-Jordan resembles the semidesert Negeb, with its rainfall fluctuation and its unstable dry-farming conditions, whereas the agriculture of the desert areas of southern and eastern Trans-Jordan is, like that of the desert areas of Palestine, limited to oases where irrigation facilities are available.

As may be seen from the agro-climatic charts of this paper, more than two-thirds of the total amount of rainfall of Palestine and Trans-Jordan usually falls between December and May, that is, during the growing period of the locally winter-sown spring wheat - which is the predominant crop on nonirrigated land of the two countries. Wheat in most years is seeded usually after the heavy rains have set in, that is, during December, although at times it is sown earlier in November. Generally speaking, under dry-farming conditions the most essential consideration appears to be the sowing of winter crops early enough to ensure the maximum use of winter precipitation. The ecological conditions of the wheat culture of Palestine suggest a similarity to those of California. Both grow spring-wheat varieties that make good winter growth when sown in November and December, and both engage in the commercial production of Australian soft-wheat varieties. The Palestinian phenological data of wheat culture; namely, the dates of sowing, germination, tillering, shooting, heading, and ripening, are rather suggestive of the wheat phenology of a number of areas in California.

The coastal-plain belt of Palestine, which represents the country's main citrus belt, is seldom subject to any frost danger, and frost is almost completely unknown in the hot, dry Jordan Valley - the major date-palm area of Palestine. Frosts are not infrequent, however, in the mountain belt, which constitutes the main center of the deciduous-fruit culture of the country.

The effect of the temperature is rather pronounced in the relative growth of a number of plant crops during the various seasons of the year in the different climatic belts of the country. In the areas subject to mild winter temperatures, that is, in the coastal plains, in the plains of the Negeb, etc., the growth of the fall-sown crops continues throughout the winter months. In the mountain belt, however, the lowering of temperature during January and February often slows down considerably the growth of some plants during these months and delays the completion of their life cycle.

The harvest periods of the winter-grown cereals and vegetable crops vary somewhat in the different belts of the country. The harvest of winter crops usually begins in May-July, depending on the region and the kind of crop. The harvest of cereals in the Jordan Valley is more than a month ahead of the harvest in the mountain area and about 2 or 3 weeks ahead of the harvest in the coastal plains. The same is more or less true of a number of varieties of vegetable and fruit species. The greater the heat summation of a given area the earlier seems to be the date of maturity of a given variety of crop species.

The effect of the various thermal environments on the date of maturity is illustrated by the distinct ripening-date regions of some varieties of table grapes in various parts of Palestine. These are: (a) The early ripening region - ripening taking place between June and August in the Valley of Jordan, the Valley of Jezreel, and the Negeb; (b) the midseason ripening region - ripening between July and September in the Plain of Sharon, the Shephelah, and the foothills of Judea, Samaria, and Galilee; (c) the late-ripening region - ripening between August and November in the mountainous districts of Judea, Samaria, and Galilee. However, in addition to the effect of the thermal environment, the rainy season, which extends in the mountains considerably later into the spring than in the plains and valleys, must also be considered among the important factors determining the date of harvest under dry-farming conditions. Thus, the agriculturally highly important late rains constitute from 12 to 20 percent of the total precipitation of the mountain belt, whereas in the plains and in the valleys they represent only from 8 to 10 percent of the total annual precipitation.

Another effect of the temperature is the crop distribution. The subtropical, as well as some of the tropical, fruit species are successfully grown in the coastal plains and in the Jordan Valley, whereas the deciduous fruits as a whole, except for a number of varieties of a few species, do not do any too well under the mild winter-temperature conditions of these regions. On the other hand, the tropical and subtropical fruits are not grown under the relatively low winter-temperature conditions of the mountain country, and the deciduous-fruit species do fairly well in a number of areas there.

A comparison of the daily mean temperatures for the period between May and October (table 2) points to the date-growing Jordan Valley as the warmest belt of Palestine and as that which resembles most nearly many high-temperature-summation areas of the torrid regions of the United States, where successful and large-scale production of the better varieties of dates is possible. The heat summation of 5,385° F. for the May-October period of Jericho (computed above a base of 50° F.) compares favorably with the heat summations computed on the same basis and for the same period of the two main American centers of the date-palm culture; namely, Coachella Valley in California and the Salt River Valley in Arizona. Thus, computed above the same base temperature of 50° F., the total heat summation of May to October - a period between blossoming and fruit maturity of the date palm - is 5,750° for Indio, California, and 5,050° for Tempe, Arizona. The same similarities exist when summations are computed above the base of 64.4° F. - the zero point for the date palm. Using this base, we find that the May-October total heat summation for the Jordan Valley is 3,720° for Jericho, 3,907° for Dagania, 3,602° for Tiberias, and 3,221° for Beisan. Computed on the same basis and for the same period of time, we find the total heat summation for Indio, Coachella Valley - the commercial date-palm center in California - is 4,020°. Similarly, the total heat summation of the date-palm center in Arizona is 3,018° for Tempe, Salt River Valley.

Soil Types and Their Plant Crops in the Various Belts

The soils of the mountains of Palestine and Trans-Jordan are mainly heavy in texture; of various degrees of water-holding capacity, fertility, and depth; and are largely of limestone origin. Some parent limestones are very hard, whereas others are chalklike and very soft. There are also some volcanic basalt soils in the highlands of eastern Galilee and in the northern part of the highland belt of Trans-Jordan. Owing to intensity of rainfall, the structure and topography of soils, and the lack of sufficient vegetative cover, the mountain soils in a great number of areas are badly washed. Many mountain areas have been rendered bare or practically bare, with little or no soil, as the result of deforestation, overgrazing, and the consequent soil erosion. These areas, as well as the numerous mountain areas covered with stones or rocks or of too steep a topography, are among the major uncultivated land areas of the mountains. However, where the soil has been terraced or otherwise protected and prevented from being severely washed, and where the land is not too steep or too rugged, these areas are intensively cultivated and devoted mainly to the production of winter- and summer-grain crops. The same is true in regard to the soils of the few broad uplands and mountain valleys. Fruit-tree culture without irrigation is also practiced in the mountain areas of favorable precipitation and soil conditions. The typical winter field crops of the mountain areas are wheat, barley, lentils, chickpeas, and vetch; the typical summer crops are mainly sesame and durra. The typical tree culture of the unirrigated mountain areas consists largely of olives, grapes, figs, carobs, pomegranates, almonds, apricots, apples, pears, plums, etc.

Immense quantities of soil are eroded constantly from the mountain slopes into the valleys between the mountains and onto the plains at the foothills of the mountains. Such washed-down alluvial soils are characteristic of the major agricultural valleys and plains which constitute the granaries of these countries. The Valley of Jezreel, the Plain of Esdraelon, the Haifa-Acre Plain, the Plain of the Philistines, the Shephelah, and the plains east of the light-soil plantation strip of the coastal belt are among such alluvial-soil areas of Palestine. These alluvial deposits, brought down from the eroding slopes of the mountains, are usually of considerable depth, heavy in texture, fairly uniform in structure, of high water-holding capacity, and productive; and their flat or gently sloping surface is conducive to mechanized farming.

The origin of these soils is either limestone or basalt, or both, depending on the parent material of their source in the mountains. The water seepage and drainage of many such soil areas are usually poor, and some of them are subject to expansion when wet and contraction and cracking when dry, which makes them somewhat difficult to handle. There are also alluvial sedimentary soils of floodwater and marshy origin formed as a result of silt deposits of the various streams and rivers and the drainage of marshes and swamps. The Huleh Plain, which also contains some areas of peat soils, and a number of areas alongside streams in the Jordan Valley and in the coastal plains represent some such sedimentary-soil areas. As a whole, the alluvial-soil areas constitute the major granaries of these countries and are intensively cultivated. They are devoted to production of winter and summer field crops under dry-farming conditions as well as under irrigation. In addition to grain, various forage and vegetable crops are among the most important crops of these areas. In the better drained soils, one finds also various fruit cultures, such as grapefruit, olives, grapes, and some other deciduous fruits. Climatic conditions are among the determining factors of the most suitable fruit species for each area. The major field crops produced under dry-farming conditions include wheat, barley, corn, durra, sesame, lentils, and vetch, whereas those produced under irrigation include mainly clovers, alfalfa, corn for fodder, etc.

One may also mention the diluvial soils of the Jordan Valley. These have been partly formed from the alluvial limestone washed down the valley from the eroding slopes of the surrounding hills and partly from the sedimentary deposits on the bed of a lake that is supposed to have once covered the Jordan Valley. The soil of the valley is usually deep, and where it is not too alkaline or can be leached of salts it is suitable for production of irrigated crops. The warm winters and very hot summers, in conjunction with the available irrigation facilities, permit the cultivation of dates, bananas, citrus, and a great number of other fruits of subtropical and tropical origin. Grapes and various out-of-season vegetables are also produced. Indian corn, alfalfa, and clover are among the other irrigated crops of this area.

The greater part of the cultivated land area of Palestine and Trans-Jordan consists of clays and silt loams, which are utilized mainly for the production of grain, fodder, and vegetable crops. In contrast to these heavy or semiheavy soils, the coastal-plain belt of Palestine consists largely of sandy or sandy-loam light soils. The major part of this light-soil area lends itself well to tree culture because of the depth of the soil. This favorable depth of soil and its texture, in conjunction with the availability of water for irrigation and the practically frost-free mild winters and high heat-summation summers, have made this area the center of the most intensive production of citrus plants in the country. Hence, this area is often referred to as the "light-soil or citrus-plantation belt" of Palestine.

Along the Mediterranean seashore and the immediate hinterland, one finds wind-blown and mobile sand dunes, which constitute a menace to the adjacent farm lands of the coastal plains. Wind-blown pure-sand areas occur also in the Negeb and in southern Trans-Jordan. East of the sand dunes of the coastal plains and embracing the Plain of Sharon and the northern part of the Plain of the Philistines stretches the "light-soil and citrus-plantation belt" of the coastal plains. Up to 80 percent and even more of this light and deep soil, which lends itself well to tree culture, consists of pure sand, with clay and rock dust making up the balance. The soil has resulted from the disintegration of calcareous sandstone and is deficient in lime. It readily absorbs water, has a rather poor moisture-holding capacity, is not too well suited to dry-farming crops, is free from excessive salinity, warms up rapidly, and is well-aerated. The light-soil area represents a strip of undulating plain, narrow in the north but widening in the south, devoted to intensive production of citrus plants, as well as to the other subtropical, semitropical, and tropical fruit species which have already been mentioned. Various vegetable and fodder crops, as well as European grapes, almonds, and apricots, are also among the crops produced in this area.

The designation "light-soil or citrus belt" actually does not apply to the whole belt of the coastal plains but to its major portion only, since the eastern, northern, and southern parts of this belt represent zones of much heavier alluvial soils largely devoted to grain crops. Within the area of deep light soils itself, especially on the Plain of Sharon, there occur also plots of heavier soils with a compact hardpan of varying thickness at an average depth of less than 3 feet below the surface of the ground. This hardpan, known locally as the "nazzaz layer" forms an impervious barrier to plant roots, restricts the movement of water in the soil, and - unless this condition is removed - prevents successful tree culture.

In addition to the wind-blown sands, there are also extensive and continuous areas of wind-transported loess soil in the plateau region of the Negeb of Palestine and in the Moab and Edom regions of Trans-Jordan. The loess represents semilight soil, 50 to 80 percent of which consists of fine sand particles and the balance of fine silt, clay, and limestone particles. The loess varies in depth but is mostly a fairly deep and easy-to-handle soil, which is slow both in absorbing water and in giving it up. With the exception of a few areas, the loess is mostly free from excessive salinity and is considered to be among the most fertile soils of the semidesert areas of these countries. In spite of the low - 6 to 10 inches per year - fluctuating rainfall of these soil areas, the high moisture-retentive properties of the loess and the abundant nightly dewfall of this area seem to permit a semistable dry-farming production of crops. Wheat and high-quality malting barley are the major field crops. Production of summer crops under dry farming is the exception rather than the rule in this region of frequent droughts and unreliable rainfall. Under irrigation, the loess soil is also suitable for the production of various fodder, vegetable, and fruit crops.

There are also strips of loess soil covered with a layer of sand in the undulating coastal plain of the Negeb. Such sand-covered loess soils are considered to have a better water absorption and are better protected from moisture evaporation that are the loess soils without the sand-mulch cover. The agricultural possibilities of such sand-covered loess soils are also better, because they permit the dry-farming production of summer crops, such as durra and watermelons, in addition to winter wheat and barley. Some fruit trees, mainly almonds, are also occasionally found growing without irrigation in these areas.

Accumulation of salt in the arid, as well as in the semiarid, regions of Palestine and Trans-Jordan constitutes a constant danger to irrigated land. A number of areas of the coastal plains have suffered from alkali soils, which developed through application of water of high salt content and through improper methods of irrigation. The arid southern region of the Jordan Valley and its Araba extension represent the chief large centers of saline soils in these countries. These saline soils, however, are mostly of the white-alkali type, since they do not contain sodium carbonate.

Experimental reclamation studies involving repeated leachings of an area at the northern end of the Dead Sea, where the salinity is very high, have been reported to be encouraging. The salinity of that experimental land area has been reduced from 17 to less than 1 percent, and the formerly desolate area is not under intensive cultivation. There are nearly 75,000 acres of saline land in the Jordan Valley. The frostless, warm winters, the high summer temperatures, and the long summers of the valley permit, under irrigation, intensive production on the alkali-free soils of a number of valuable crops. These include alfalfa, clover, various early vegetables, dates, bananas, citrus, and a great number of other tropical and subtropical fruit plants. The production of such crops is regarded, under certain conditions, as a sufficient incentive for the reclamation of saline lands.

Summary of Some Major Climate-Crop-Soil Relationships

Cereal growing is the most important agricultural characteristic of the great majority of the nonirrigated farm enterprises. As a whole, cereal crops predominate in the native rain-fed agriculture of these two countries, where winter-sown wheat and barley and the summer cultures - durra and sesame - are the chief crops. Satisfactory summer crops are usually difficult to grow in most areas unless they have been fallowed the preceding winter to conserve the soil moisture. The crop-rotation systems practiced by the native farmers vary and consist of three major types: (1) A 2-year crop rotation in which wheat, or barley, is followed by summer crops of durra or sesame or by a winter legume; (2) a 3-year rotation in which a legume is introduced as an additional winter crop between the summer and winter cereals; (3) a monoculture of barley alternating with a year of bare fallow in the more arid regions of the countries. In the typical native rotation, wheat, or barley, is sown during November and December and harvested during May and June. The land is then left bare until the following April, when it is sown with durra or sesame. These are harvested in August and followed again by a winter cereal or by a legume in a 3-year rotation. In many of the European-type settlements of Palestine, a 4-year rotation for rain-fed agriculture has been adopted, which includes a hay, a silage, or a green-manure crop.

Wheat, the chief cereal, is grown in practically all the regions of Palestine and in a great number of areas in Trans-Jordan. In general, within the cereal-growing areas of these countries the heavier and deeper soils are devoted to wheat, whereas others that are lighter in texture and shallower are sown to barley because of their poorer capacity for holding water. In the south, where the rainfall is lighter and the rainy season is shorter, barley is again the leading crop. The great alluvial plains and valleys, with their deep and heavy soils of high water-holding capacity, and the fairly extensive plains of some of the mountain plateaus are the best and the major local wheat areas. However, a considerable part of the wheat area of these countries is also made up of relatively small strips of shallow soils of the mountain terraces, mountain slopes, and foothills. The local wheat consists mainly of a number of native drought-resistant durum varieties, a few introduced soft-wheat varieties of Australian origin, and some semisoft hybrids of the two. Early ripening is a highly important characteristic of wheat varieties for the local conditions, because late varieties are apt to be subject to great damage by hot sirocco winds in early May if caught during their yellow-ripe stage.

Sesame requires more moisture than durra and is therefore almost entirely confined to the northern areas of these countries, where the precipitation conditions are more favorable. Durra, on the other hand, is grown in most of the agricultural areas and is the summer crop of the relatively low rainfall areas. Corn can be grown without irrigation mainly in the north. Chickpeas and lentils, peas, beans, and vetch are the principal winter legumes of these soils.

In these subtropical countries, with their warm climates and long rainless summers, the growing of fodder crops, and many various vegetable and fruit crops, can be successfully attempted mostly under irrigation. In the more arid areas - such as in the Jordan Valley and in the Negeb - irrigation is also needed for a satisfactory production of field crops. Farming under irrigation permits a more intensive crop production, as well as the cultivation of a greater variety of crops and a wider crop-rotation system. It results also in higher yields, permits the production of more than one crop a year, and favors a sounder and more rational utilization of the highly diverse thermal and soil conditions of these countries. Production of citrus fruits, bananas, forage and fodder crops for dairy farming, and the cultivation of a great number of various vegetable crops have been made possible through irrigation.

The mild winter conditions and the almost complete absence of damaging frosts, the high total summation of heat units and sunshine throughout the long growing period, the relatively high atmospheric humidity, and the adequate supply of irrigation water of the coastal plains, in conjunction with the light deep soils of the main part of this belt, are all conducive to good growth and yield. They permit an intensive cultivation of the various citrus species, bananas, and a great number of other subtropical and tropical fruits; also, the cultivation of a great number of various vegetables throughout most of the year, as well as the production of various fodder crops. While formerly the center of the grape-growing industry of Palestine, the light-soil region of the coastal plains is now almost completely overtaken by citrus culture. Orange trees are usually planted on the lighter soils and grapefruit trees on light and heavy soils. Bananas, vegetables, and forage crops are often grown in the heavier soils of this belt. Windbreaks are often needed on the eastern side of the plantings to protect them from the adverse effects of the strong desert winds.

Out-of-season, early, or winter vegetables, dates, bananas, citrus, and a great number of other tender subtropical and tropical fruit species requiring very high heat are grown under irrigation in the alkali-free loam and clay soils of the Jordan Valley, where the winters are warm and frostless and the summers long and very hot. The Jordan Valley is also the main alfalfa region of these countries owing to the favorable physical properties and fertility of its soil.

Irrigation facilities are scarce in the mountains. Grain crops, vegetables, and numerous tree and vine fruits are produced without irrigation in the mountains. The olive tree produces without irrigation and is well-adapted to the rocky, heavy soils of the mountain belt. Most of the grape vineyards, and also the fig, carob, and almond trees scattered throughout the countryside, are not irrigated. The relatively low winter temperatures of the higher elevations of the mountain areas provide better climatic conditions for deciduous fruits than do the milder winter temperatures of the other areas of Palestine and Trans-Jordan, particularly for a large number of varieties. With most of these, apparently the lower the winter temperature and the longer its duration in a given area the more satisfactory is the production of the fruit.

Under the climatic conditions of Palestine, cherries grow satisfactorily at an altitude of 2,000 to 2,600 feet above sea level and higher. At lower elevations and, consequently, milder winter temperatures, they produce either little or no fruit at all. Very similar altitude requirements apply to European plums. The behavior of many varieties of the Japanese plum is quite different, however, since they do not seem to require colder winters in order to bloom early enough to escape injury from the hot desert winds of May. Some Japanese-plum varieties produce well not only in the mountains but also in the lowland plains and valleys of Palestine. Some such varieties do well even in the Jordan Valley, where the winters are warm. On the other hand, some other varieties of this plum, if they are to bloom early enough in spring to avoid the hot desert winds, must be grown at an elevation above 1,700 to 2,000 feet. One variety, the Formosa, when grown at such an altitude, blooms during March and sets and matures its fruit well; but, when grown in the warm winter lowlands, it blooms during late April and early May and sets no fruit owing to the hot sirocco winds of that time. Apples, pears, peaches, apricots, and nectarines are grown fairly successfully in a number of areas in the higher altitude mountain regions; however, some varieties seem to do well also in the warmer parts of Palestine.

Satisfactory deciduous-fruit culture without irrigation appears to be possible only in Upper Galilee, in the region of Mount Carmel, and in a few other isolated locations of a relatively high annual precipitation. Production of the deciduous fruits under dry-farming conditions in a number of areas of lesser precipitation has resulted in the weakening of the trees and in poor yields. Lack of sufficient moisture seems to have caused many such trees to become highly susceptible to various pests and diseases and has shortened their life span. Where irrigation is practiced, deciduous fruit trees return higher yields and live longer. The same applies more or less to the grapevine, although it produces fairly well under dry-farming conditions in areas where the annual precipitation is 24 inches or more. Earlier grapes are produced at lower altitudes, whereas late varieties are produced in the higher altitudes. At an elevation of not less than 300 feet above sea level, where precipitation is about 20 inches per year and relative humidity and dewfall are fairly high, one often finds a satisfactory production of almonds under dry-farming conditions.

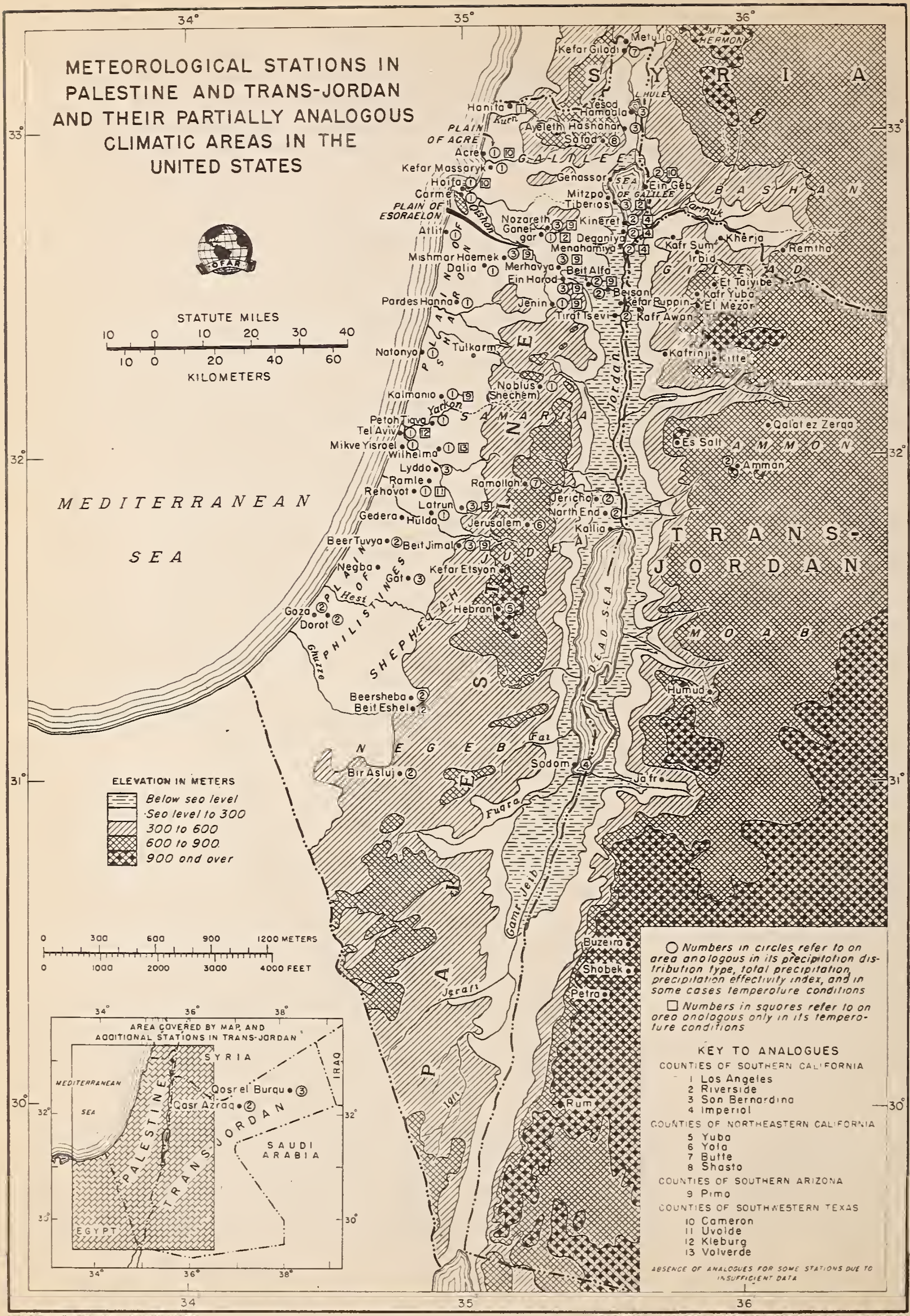
The depth, salinity, and lime content of the soils are also important factors in the distribution and performance of deciduous fruit trees in Palestine. Lime tolerance of different species, as well as that of various varieties of a number of species, has been found to differ greatly.

The climatic conditions of the mountain region seem also to be more suited to seed-growing production of some vegetable crops, such as cauliflower, cabbage, beets, carrots, and radishes, than are the warmer winter areas of Palestine, where the seed of many other vegetables is produced. Cultivation of vegetables without irrigation in the mountain zone during the summer is most successful in the case of tomatoes. They are plentiful in this zone in the late summer at a time when they can no longer grow in the warmer areas of the country. Production of autumn cauliflower and spring potatoes seems also to be well-suited to the cooler climatic conditions of the mountains.

The climatic and soil conditions of the great alluvial plains and valleys, the centers of grain production in these countries, favor a great variety of crops and highly diversified farming under irrigation conditions. Fodder and vegetables, as well as many kinds of fruits, are successfully grown wherever irrigation facilities are available.

The relative performance of the local winter- and summer-grain crops under dry-farming conditions can serve as a rough indication of the need for artificial irrigation in the various regions and areas of Palestine and Trans-Jordan. On the basis of such an approach, the need seems to be greatest in central and southern Jordan Valley, in the Negeb, and in southern and eastern Trans-Jordan. Neither summer- nor winter-grain crops can be produced in most of those regions without irrigation, except in the central part of the Jordan Valley and the loess-soil region of the Negeb and Trans-Jordan where meager winter and occasionally very poor summer crops are produced. Both winter and summer crops can be grown, however, without irrigation in the heavy soils of the coastal plains and in most of the other great alluvial plains and valleys, on the western slopes of the mountains of Palestine, and in the Gilead region of the highlands of Trans-Jordan.

The field data of the relative performance of grain crops under dry-farming conditions in the various areas of Palestine and Trans-Jordan can be interpreted in the light of the climatic and soil characteristics of those areas. Some of the major factors determining the relative performance of the locally grown field crops can be formulated through a generalization stating that it is progressively more satisfactory with the following: Greater amounts of yearly rainfall and greater percentage of "late" spring rains; smaller intensity and smaller yearly fluctuations of rainfall; higher relative humidity and greater dewfall; lower temperatures, lower wind velocity, and fewer days of dry desert winds; higher precipitation-effectivity ratios and indexes; smaller water run-off, greater water absorption, and greater water-holding capacity of soil.



METEOROLOGICAL STATIONS IN PALESTINE AND TRANS-JORDAN AND THEIR PARTIALLY ANALOGOUS CLIMATIC AREAS IN THE UNITED STATES

○ Numbers in circles refer to an area analogous in its precipitation distribution type, total precipitation, precipitation effectivity index, and in some cases temperature conditions

☐ Numbers in squares refer to an area analogous only in its temperature conditions

KEY TO ANALOGUES

COUNTIES OF SOUTHERN CALIFORNIA
1 Los Angeles
2 Riverside
3 San Bernardino
4 Imperial

COUNTIES OF NORTHEASTERN CALIFORNIA
5 Yuba
6 Yolo
7 Butte
8 Shasta

COUNTIES OF SOUTHERN ARIZONA
9 Pima

COUNTIES OF SOUTHWESTERN TEXAS
10 Cameron
11 Uvalde
12 Kleburg
13 Valverde

ABSENCE OF ANALOGUES FOR SOME STATIONS DUE TO INSUFFICIENT DATA

U.S. DEPARTMENT OF AGRICULTURE NEG. 738 OFFICE OF FOREIGN AGRICULTURAL RELATIONS

Station Reference No.	PALESTINIAN AGRO-CLIMATIC ANALOGUES IN THE UNITED STATES (Based on analogy of precipitation distribution, amount of precipitation, precipitation effectivity index, and also in most cases temperature conditions. Where the latter is different another area is indicated in the column under the heading Temperature Analogues)			Latitude	Altitude	PALESTINIAN TEMPERATURE ANALOGUES IN THE UNITED STATES (Based on analogy of temperature conditions only)		Latitude	Altitude
1	Riverside, Riverside County,	S. California.	Somewhat cooler. 2" more precip.	34°	851'	Same as agro-climatic analogue.			
2	Riverside, Riverside County,	S. California.	- - - - -	34°	851'	" " " " "			
3	Mecca, Riverside County,	S. California.	Somewhat warmer.	33°40'	185'	Elsinore, Riverside County,	S. California	33° 35'	1.300'
4	Amos, Imperial County,	S. California.	- - - - -	33° 1'	255'	Same as agro-climatic analogue.			
5	Corona, Riverside County,	S. California.	- - - - -	33°58'	1,049'	" " " " "			
6	Arrowhead Springs, San Bernardino,	S. California.	- - - - -	34° 3'	2,000'	" " " " "			
7	Elsinore, Riverside County,	S. California.	Slightly cooler. 1" less precip.	33°35'	1,300'	" " " " "			
8	- - - - - *	- - - - -		- -	- -	- - - -	- - - -	- -	- -
9	Corona, Riverside County,	S. California.	Slightly cooler summers. 3" less precip.	33°58'	1,049'	Same as agro-climatic analogue.			
10	- - - -	- - - -		- -	- -	- - - -	- - - -	- -	- -
11	Fontana, San Bernardino County,	S. California.	Somewhat cooler. 3" less precip.	34° 2'	1,325'	Same as agro-climatic analogue.			
12	Azusa, Los Angeles County,	S. California.	Somewhat cooler.	34° 3'	540'	" " " " "			
13	Azusa, Los Angeles County,	S. California.	Slightly cooler. 3" less precip.	34° 3'	540'	" " " " "			
14	Sierra Madre, Los Angeles County,	S. California.	Somewhat cooler.	34° 4'	1,100'	" " " " "			
15	- - - - - *	- - - -		- -	- -	- - - -	- - - -	- -	- -
16	Los Angeles, Los Angeles County,	S. California.	Somewhat cooler. 3" less precip.	34° 3'	338'	Sabinal, Uvalde County,	S. W. Texas.	29°15'	964'
17	- - - - - *	- - - -		- -	- -	- - - -	- - - -	- -	- -
18	Sierra Madre, Los Angeles County,	S. California.	Somewhat cooler.	34° 4'	1,100'	Same as agro-climatic analogue.			
19	Azusa, Los Angeles County,	S. California.	Somewhat cooler. 2" less precip.	34° 3'	540'	Ricardo, Kleberg County,	S. W. Texas.	27° 20'	35'
20	Pasadena, Los Angeles County,	S. California.	Somewhat cooler. 2" less precip.	34° 3'	805'	Del Rio, Val Verde County,	S. W. Texas.	29°16'	944'
21	- - - - - *	- - - -		- -	- -	- - - -	- - - -	- -	- -
22	San Bernardino, San Bernardino Co,	S. California.	Somewhat cooler.	34° 2'	1,054'	Silverbell, Pima County,	S. Arizona.	32°25'	2,990'
23	Davis, Yolo County,	N.E. California.	Slightly cooler winters.	38°30'	51'	Same as agro-climatic analogue.			
24	Wheatland, Yuba County	N.E. California.		39° 1'	84'	" " " " "			
25	- - - - - *	- - - -		- -	- -	- - - -	- - - -	- -	- -
26	Upland, San Bernardino County,	S. California.	Somewhat cooler. 2" less precip.	34° 1'	1,750'	Silverbell, Pima County,	S. Arizona.	32°25'	2,990'
27	Oroville, Butte County,	N.E. California.	Somewhat warmer summers; cooler autumn	39°30'	250'	Same as agro-climatic analogue.			
28	Sierra Madre, Los Angeles County,	S. California.	Somewhat cooler.	34°4'	1,100'	Indian Oasis, Pima County,	S. Arizona.	31°55'	2,400'
29	- - - - - *	- - - -		- -	- -	- - - -	- - - -	- -	- -
30	Azusa, Los Angeles County,	S. California.	Somewhat cooler.	34° 3'	540'	Same as agro-climatic analogue.			
31	Azusa, Los Angeles County,	S. California.	Somewhat cooler. 3" less precip.	34° 3'	540'	" " " " "			
32	- - - - *	- - - -		- -	- -	- - - -	- - - -	- -	- -
33	Azusa, Los Angeles County,	S. California.	Slightly cooler. 3" less precip.	34° 3'	540'	Same as agro-climatic analogue.			
34	Sierra Madre, Los Angeles County,	S. California.	Slightly cooler. 2" less precip.	34° 4'	1,100'	" " " " "			
35	Azusa, Los Angeles County,	S. California.	Considerably cooler.	34° 3'	540'	" " " " "			
36	Sierra Madre, Los Angeles County,	S. California.	Somewhat cooler.	34° 4'	1,100'	Raymondville, Cameron County,	S. W. Texas.	26°30'	31'
37	Newhall, Los Angeles County,	S. California.	Somewhat cooler. 2" less precip.	34°28'	1,200'	Indian Oasis, Pima County,	S. Arizona.	31°55'	2,400'
38	Pomona, Los Angeles County,	S. California.	Somewhat cooler. 4" less precip.	34° 1'	870'	Same as agro-climatic analogue.			

* Insufficient data to formulate analogues.

AGRO-CLIMATIC CHART OF PALESTINE
AND PALESTINIAN CLIMATIC ANALOGUES
IN THE UNITED STATES

METEOROLOGICAL STATIONS	Station Reference No.	Latitude	Longitude	Altitude	Years Record	MEAN TEMPERATURE (In Fahrenheit) Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly	ABSOLUTE TEMPERATURE Abs. Max.	Abs. Min.[1]
NEGEV (Desert of the South)																				
Beersheba	1	31°14'	34°47'	938'	13	54.0	54.0	60.0	66.0	73.0	77.0	79.0	80.0	77.0	73.0	67.0	58.0	68.0	115	23
Beit Eshel	2	31°13'	34°48'	- -	1	- -	52.9	57.7	68.0	68.0	76.8	77.0	77.2	- -	- -	- -	.	- -	113	34
Bir Asluj	3	31° 3'	34°46'	- -	1	52.0	55.8	61.5	68.7	68.4	79.5	79.5	80.0	- -	- -	- -	59.5	- -	108	37
Sodom	4	31° 7'	35°22'	-1210'	3	61.5	63.5	69.1	75.6	86.9	90.7	91.9	92.1	88.9	84.0	72.9	62.4	78.9	109	46
THE SOUTH																				
Dorot	5	31°30'	34°30'	- -	2	52.9	54.5	58.5	65.1	70.2	68.7	75.0	76.6	74.8	74.3	65.1	56.8	66.0	106	37
Gat	6	31°37'	34°47'	- -	1	54.7	58.5	62.1	69.1	69.8	78.3	80.1	- -	79.3	- -	- -	- -	- -	102	35
Gaza	7	31°30'	34°28'	158'	13	55.0	56.0	60.0	64.0	.70.0	74.0	77.0	78.0	76.0	72.0	67.0	59.0	67.0	112	30
Negba	8	31°39'	34°41'	- -	4	54.5	55.6	56.8	63.0	68.7	72.5	75.9	76.5	74.3	71.6	66.6	56.7	66.1	102	38
PLAIN OF JUDEA (Plain of the Philistines)																				
Beer Tuvya	9	31°45'	34°43'	- -	4	55.0	56.7	59.7	64.6	70.7	74.7	77.2	77.9	75.7	72.0	67.1	58.5	67.5	97	40
Gedera	10	31°49'	34°48'	272'	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-
Lydda	11	31°58'	34°54'	- -	2	54.1	54.1	57.0	61.9	67.3	74.8	76.8	78.1	76.5	71.8	66.9	58.6	66.5	106	36
Mikve Yisrael	12	32° 2'	34°47'	- -	8	54.1	54.1	57.6	63.0	69.1	73.4	77.5	78.4	76.1	72.1	65.5	57.4	66.5	101	35
Hulda	13	31°49'	34°53'	492'	1	54.5	56.6	60.1	66.2	68.4	76.6	78.1	78.1	- -	77.0	72.5	61.7	--	120	43
Petah Tikva	14	32° 6'	34°53'	180'	5	54.9	54.1	57.4	65.3	72.3	75.7	79.3	79.5	77.5	73.8	63.7	57.0	67.5	- -	-
Ramle	15	31°56'	34°53'	262'	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	96	38
Rehovot	16	31°53'	34°48'	- -	4	56.3	57.2	59.0	66.0	71.6	74.8	77.7	78.8	76.6	72.0	64.6	58.8	67.8	103	35
Rishon le Zion	17	31°58'	34°47'	230'	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-
Sarona	18	32° 4'	34°49'	66'	5	55.0	57.0	60.0	65.0	70.0	74.0	78.0	79.0	77.0	72.0	65.0	59.0	68.0	102	32
Tel Aviv	19	32° 4'	34°47'	105'	12	55.0	58.0	61.0	66.0	71.0	76.0	80.0	81.0	78.0	73.0	66.0	58.0	69.0	115	37
Wilhelmia	20	32° 3'	34°55'	131'	10	52.0	56.0	59.0	66.0	70.0	76.0	80.0	80.0	78.0	73.0	63.0	58.0	68.0	- -	-
MOUNTAINS AND HILLS OF JUDEA																				
Artuf	21	31°46'	34°49'	820'	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-
Beit Jimal	22	31°43'	34°58'	1148'	10	55.0	55.0	61.0	67.0	73.0	76.0	79.0	80.0	78.0	76.0	67.0	59.0	69.0	113	33
Jerusalem	23	31°47'	35°13'	2485'	16	47.0	48.0	55.0	61.0	69.0	73.0	75.0	75.0	73.0	69.0	62.0	52.0	63.0	107	26
Hebron	24	31°32'	35° 7'	2900'	18	45.0	48.0	51.0	58.0	66.0	69.0	72.0	73.0	71.0	67.0	57.0	49.0	60.0	103	19
Kefar Etzyon	25	31°38'	35° 7'	- -	1	43.7	48.4	51.3	59.7	63.9	- -	- -	73.4	- -	- -	--	54.1	- -	91	32
Latrun	26	31°50'	34°59'	656'	11	54.0	57.0	60.0	67.0	74.0	77.0	80.0	82.0	79.0	75.0	67.0	59.0	69.0	114	27
Ramallah	27	31°54'	35°11'	- -	1	45.0	49.0	55.0	62.0	64.0	73.0	72.0	73.0	73.0	71.0	64.0	55.0	63.0	96	28
PLAIN OF SHARON																				
Kalmania	28	32°11'	34°55'	216'	3	53.6	58.5	63.3	64.9	69.6	72.5	75.4	77.5	75.6	74.1	65.1	55.8	67.1	106	37
Karkur	29	32°28'	35°	230'	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-
Natanya	30	32°19'	34°52'	- -	4	56.8	56.7	59.0	64.0	68.9	73.9	76.6	77.7	77.2	74.7	66.9	59.4	67.7	102	41
Pardes Hanna	31	32°28'	34°57'	- -	5	54.1	56.7	59.0	65.3	69.1	73.9	77.0	78.3	76.8	75.4	68.4	58.5	67.7	102	40
Tulkarm	32	32°19'	35° 2'	591'	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-
SAMARIA																				
Atlit	33	32°42'	34°56'	16'	1	57.0	59.0	62.0	- -	69.0	- -	- -	- -	80.0	78.0	74.0	62.0	- -	108	34
Carmel	34	32°47'	35°	974'	10	51.0	55.0	57.0	62.0	69.0	71.0	75.0	76.0	75.0	71.0	63.0	56.0	65.0	94	39
[illegible]	35	[illegible]	35° 4'	- -	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	77.2	[illegible]	[illegible]	[illegible]	67.9	100	40
Haifa	36	32°48'	34°59'	52'	13	57.0	58.0	62.0	67.0	74.0	78.0	82.0	83.0	81.0	76.0	69.0	60.0	71.0	108	36
Jenin	37	32°28'	35°18'	525'	12	51.0	52.0	58.0	63.0	72.0	77.0	80.0	81.0	79.0	74.0	65.0	55.0	67.0	110	31
Nablus (Shechem)	38	32°13'	35°16'	- -	1	48.9	52.3	58.1	64.8	66.6	74.5	75.2	76.1	- -	- -	- -	- -	- -	95	27

METEOROLOGICAL STATIONS	Years Record	AVERAGE PRECIPITATION (In inches) Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly	Precipitation Effectivity Index	Years Record	RELATIVE HUMIDITY (in %) Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly
NEGEV (Desert of the South)																													
Beersheba	13	1.9	2.2	0.7	0.4	0.1	0.0	0.0	0.0	0.0	0.1	0.8	1.6	7.8	13.0	13	78	75	67	57	53	59	67	67	70	66	67	72	66
Beit Eshel	1	4.1	0.3	1.2	0.4	0.2	0.0	0.0	0.0	0.0	0.4	0.4	0.5	7.5	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bir Asluj	4	0.8	0.8	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.6	4.7	— —	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodom	1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.4	1.2	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
THE SOUTH																													
Dorot	3	4.8	1.6	2.2	1.3	0.3	0.0	0.0	0.0	0.0	1.3	0.9	3.6	16.0	28.6	1	64	76	64	56	53	48	77	79	71	67	72	72	67
Gat	3	6.6	1.8	2.6	1.1	0.4	0.0	0.0	0.0	0.0	1.5	0.9	7.6	22.5	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gaza	13	3.6	3.4	0.7	0.7	0.1	0.0	0.0	0.0	0.0	0.3	1.4	3.6	13.8	24.1	13	77	75	69	65	63	67	72	72	71	70	69	73	70
Negba	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1	65	49	48	49	58	66	62	62	70	69	65	68	62
PLAIN OF JUDEA (Plain of the Philistines)																													
Beer Tuvya	19	4.9	3.6	1.4	0.4	0.1	0.0	0.0	0.0	0.0	0.6	1.9	4.7	17.6	31.5	1	76	58	56	61	72	-	-	-	76	77	73	75	-
Gedera	9	3.2	4.1	3.1	0.4	0.4	0.0	0.0	0.0	0.0	1.0	2.8	5.6	17.3	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lydda	4	5.1	4.1	2.8	0.9	0.0	0.0	0.0	0.0	0.0	2.2	5.0	3.7	23.8	41.8	1	71	64	62	57	61	56	62	61	59	58	57	66	59
Mikve Yisrael	17	5.4	3.6	0.7	0.6	0.1	0.0	0.0	0.0	0.4	1.1	2.7	5.8	20.4	37.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hulda	3	5.6	4.8	1.4	1.2	0.0	0.6	0.0	0.0	0.0	1.1	4.4	3.1	22.2	— —	1	52	39	41	46	56	49	58	55	-	60	55	53	51
Petah Tikva	18	5.8	4.1	0.7	0.7	0.2	0.0	0.0	0.0	0.5	0.9	2.8	5.2	23.2	38.3	4	-	-	71	74	74	77	80	79	80	80	76	79	-
Ramle	12	5.9	4.1	1.1	0.5	0.1	0.0	0.0	0.0	0.2	1.0	2.3	2.8	16.2	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rehovot	13	5.7	4.4	0.7	0.7	0.1	0.0	0.0	0.0	0.0	0.9	2.5	3.5	18.8	32.5	3	68	67	78	68	67	69	69	-	78	72	68	62	-
Rishon le Zion	28	6.5	4.4	1.4	0.8	0.2	0.0	0.0	0.0	0.2	1.1	3.1	5.7	23.6	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sarona	5	5.6	3.9	2.7	0.9	0.1	0.1	0.0	0.0	0.2	1.4	3.2	5.6	23.6	42.3	9	76	75	71	71	71	73	74	72	70	-70	71	73	72
Tel Aviv	12	5.6	4.5	0.6	0.6	0.2	0.0	0.0	0.0	0.1	0.8	3.1	5.2	20.8	36.9	2	85	87	82	75	78	80	80	76	74	77	81	77	79
Wilhelmia	10	4.2	3.1	2.4	1.0	0.1	0.0	0.0	0.0	0.1	0.8	2.6	5.1	19.4	34.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOUNTAINS AND HILLS OF JUDEA																													
Artuf	7	4.1	5.8	1.8	1.3	0.0	0.0	0.0	0.0	0.0	1.8	1.2	3.6	19.7	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beit Jimal	10	4.3	4.0	1.1	0.7	0.1.	0.0	0.0	0.0	0.0	0.6	2.8	2.5	16.1	28.0	9	74	74	67	59	56	63	68	73	73	67	66	69	67
Jerusalem	16	4.1	5.3	1.1	1.0	0.1	0.0	0.0	0.0	0.0	0.2	1.2	2.9	15.9	34.1	10	78	72	60	52	44	46	50	55	60	58	62	73	69
Hebron	18	6.2	4.6	3.4	2.0	0.3	0.1	0.0	0.0	0.1	0.5	2.1	5.1	24.3	55.2	16	83	78	74	62	53	54	55	59	63	62	72	60	66
Kefar Etzyon	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Latrun	11	6.5	3.3	2.8	1.3	0.3	0.1	0.0	0.0	0.1	0.9	2.4	5.2	22.8	40.7	9	65	63	62	57	49	53	53	55	57	55	55	61	57
Ramallah	5	10.0	7.4	2.9	0.9	0.2	0.0	0.0	0.0	0.0	0.9	3.1	3.8	29.4	66.9	1	82	63	57	54	58	49	62	59	67	58	58	59	60
PLAIN OF SHARON																													
Kalmania	1	7.0	4.4	0.8	0.4	0.2	0.0	0.0	0.0	0.2	1.1	3.1	4.8	22.2	41.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Karkur	10	5.0	4.8	1.1	1.0	1.0	0.0	0.0	0.0	0.0	0.5	1.0	5.1	19.5	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Natanya	5	6.3	3.3	0.7	0.3	0.2	0.0	0.0	0.0	0.0	1.5	5.7	4.1	20.5	38.1	1	78	70	71	75	79	84	84	85	74	74	72	79	74
Pardes Hanna	7	5.1	4.2	1.0	1.0	0.2	0.3	0.0	0.0	0.0	1.4	4.4	4.8	22.4	39.1	1	72	62	61	57	65	65	67	66	61	59	57	67	63
Tulkarm	16	6.1	5.3	0.8	0.6	0.4	0.0	0.0	0.0	0.1	0.8	3.1	4.6	22.0	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SAMARIA																													
Atlit	10	5.4	4.1	0.8	0.7	0.6	0.0	0.0	0.0	0.3	1.4	4.6	4.8	22.7	— —	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carmel	10	6.8	4.1	2.2	0.9	0.4	0.0	0.0	0.0	0.0	0.8	5.1	6.1	26.4	51.2	1	72	77	69	69	70	73	76	78	76	68	64	69	72
[illegible]	3	9.6	2.1	1.9	1.4	0.2	0.0	0.0	0.0	0.0	1.6	2.2	2.2	21.4	37.0	1	65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Haifa	13	7.1	5.7	0.9	0.7	0.1	0.0	0.0	0.0	0.0	0.5	2.7	6.7	24.4	44.0	9	72	71	69	69	70	72	71	68	67	66	69	72	69
Jenin	12	5.1	5.4	1.1	1.2	0.1	0.0	0.0	0.0	0.0	0.3	1.7	4.1	19.0	37.5	2	62	67	62	61	61	63	64	66	67	66	61	59	63
Nablus (Shechem)	1	12.6	2.2	2.2	0.9	1.4	0.0	0.0	0.0	0.0	0.9	0.0	2.3	22.5	- -	1	72	57	55	46	56	53	61	59	-	-	-	-	-

[1] Frost and Snow: Coastal Plain - Frost and snow almost unknown. The Hill and Mountain Country - Occasional slight frost and snow not infrequent. The Jordan Valley - Frost and snow entirely unknown.

(Continued on next page)

Station Reference No.	PALESTINIAN AGRO-CLIMATIC ANALOGUES IN THE UNITED STATES			Latitude	Altitude	PALESTINIAN TEMPERATURE ANALOGUES IN THE UNITED STATES		Latitude	Altitude
	(Based on analogy of precipitation distribution, amount of precipitation, precipitation effectivity index, and also in most cases temperature conditions. Where the latter is different another area is indicated in the column under the heading Temperature Analogues)					(Based on analogy of temperature conditions only)			
39	San Bernardino, San Bernardino County,	S. California.	Somewhat cooler. 2" less precip.	34° 2'	1,054'	Same as agro-climatic analogue.			
40	Elsinore, Riverside County,	S. California.	Considerably cooler.	33°35'	1,300'	Indian Oasis, Pima County,	S. Arizona.	31°55'	2,400'
41	Redlands, San Bernardino County,	S. California.	Somewhat cooler. 3" less precip.	34° 1'	1,352'	Silverbell, Pima County,	S. Arizona.	32°25'	2,990'
42	Sierra Madre, Los Angeles County,	S. California.	Cooler summers.	34° 4'	1,100	Elsinore, Riverside County,	S. Calif.	33°35'	1,300'
43	Redlands, San Bernardino County,	S. California.	Somewhat cooler. 4" less precip.	34° 1'	1,352'	Silverbell, Pima County,	S. Arizona.	32°25'	2,990'
44	Fontana, San Bernardino County,	S. California.	Somewhat cooler. 2" less precip.	34° 2'	1,325'	Indian Oasis, Pima County,	S. Arizona.	31°55'	2,400'
45	Sierra Madre, Los Angeles County,	S. California.	Somewhat cooler.	34° 4'	1,100'	San Bernardino, San Bernardino County,	S. Calif.	34° 2'	1,054'
46	Sierra Madre, Los Angeles County,	S. California.	Somewhat cooler.	34° 4'	1,100'	Raymondville, Cameron County,	S.W. Texas.	26°30'	31'
47	Azusa, Los Angeles County,	S. California.	Slightly cooler winters.	34° 3'	540'	Same as agro-climatic analogue.			
48	- - - - - *	- - - -		- -	--	- - - -		- -	- -
49	- - - - - *	- - - -		- -	- -	- - - -		- -	- -
50	Arrowhead Springs, San Bernardino Co.,	S. California.	Slightly cooler.	34° 3'	2,000'	Same as agro-climatic analogue.			
51	- - - - - *	- - - -		- -	- -	- - - -		- -	- -
52	Mill Creek (No. 2), San Bernardino Co.,	S. California.	Somewhat cooler. 3" less precip.	34° 1'	2,950'	Fresnal School Ranch, Pima Co.,	S. Arizona.	32°	4,000'
53	Fontana, San Bernardino County,	S. California.	Somewhat cooler summers.	34° 2'	1,325'	Redlands, San Bernardino Co.,	S. Calif.	34° 1'	1,352'
54	Marysville, Yuba County,	N. E. California.	Somewhat cooler. 2" less precip.	39° 5'	67'	Same as agro-climatic analogue.			
55	- - - - - *	- - - -		- -	- -	- - - -		- -	- -
56	- - - - - *	- - - -		- -	- -	- - - -		- -	- -
57	Oroville, Butte County,	N. E. California.	Slightly cooler winters.	39°30'	250'	Same as agro-climatic analogue.			
58	- - - - - *	- - - -		- -	- -	- - - -		- -	- -
59	- - - - - *	- - - -		- -	- -	- - - -		- -	- -
60	Redding, Shasta County,	N. E. California.	Slightly cooler winters.	40°40'	590'	Same as agro-climatic analogue			
61	Fontana, San Bernardino County,	S. California.	Somewhat cooler summers.	34° 2'	1,325'	Redlands, San Bernardino Co.,	S. Calif.	34° 1'	1,352'
62	Riverside, Riverside County,	S. California.	Considerably cooler.	34°	851'	Mecca, Riverside County,	S. Calif.	33°40'	185'
63	Elsinore, Riverside County,	S. California.	Considerably cooler. 3" less precip.	33°35'	1,300'	Imperial, Imperial County,	S. Calif.	32°58'	65'
64	- - - - - - - - *	- - - -		- -	- -	- - - -		- -	- -
65	Palm Springs, Riverside County,	S. California.	- - - -	33°59'	584'	Same as agro-climatic analogue.			
66	- - - - - *	- - - -		- -	- -	- - - -		- -	- -
67	- - - - - *	- - - -		- -	- -	- - - -		- -	- -
68	Elsinore, Riverside County,	S. California.	Considerably cooler. 8" less precip.	33°35'	1,300'	Imperial, Imperial County,	S. Calif.	32°58'	65'
69	Elsinore, Riverside County,	S. California.	Somewhat cooler. 4" less precip.	33°35'	1,300'	Imperial, Imperial County,	S. Calif.	32°58'	65'
70	Indio, Riverside County,	S. California.	- - - -	33°50'	20'	Same as agro-climatic analogue.			
71	San Bernardino, San Bernardino County,	S. California.	Considerably cooler. 4" less precip.	34° 2'	1,054'	Mecca, Riverside County,	S. Calif.	33°40'	185'
72	Elsinore, Riverside County,	S. California.	Somewhat cooler.	33°35'	1,300'	Mecca, Riverside County,	S. Calif.	33°40'	185'

* Insufficient data to formulate analogues.

AGRO-CLIMATIC CHART OF PALESTINE
AND PALESTINIAN CLIMATIC ANALOGUES
IN THE UNITED STATES

(Continued)

METEOROLOGICAL STATIONS	Station Reference No.	Latitude	Longitude	Altitude	Years Record	MEAN TEMPERATURE (In Fahrenheit)													ABSOLUTE TEMPERATURE	
						Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly	Abs. Max.	Abs. Min.[1]
PLAIN OF ESDRAELON and VALLEY OF JEZREEL																				
Afula	39	32°36'	35°17'	- -	2	53.4	54.3	58.1	64.4	69.8	76.6	79.9	81.5	77.9	73.8	66.2	57.2	67.6	- -	-
Beit Alfa	40	32°31'	35°26'	-229'	3	54.9	56.8	60.3	67.6	74.7	77.5	84.2	85.1	81.9	78.1	67.6	58.8	70.8	106	37
Ein Harod	41	32°33'	35°21'	14'	3	53.1	56.7	59.9	68.9	74.1	79.7	81.5	82.2	79.0	75.2	68.4	56.1	69.6	108	37
Gingar	42	32°41'	35°16'	656'	6	52.9	52.9	55.8	65.3	73.0	76.6	79.2	79.5	77.4	73.8	64.4	55.8	67.2	109	41
Merhavya	43	32°36'	35°19'	295'	7	53.8	57.0	61.0	69.3	73.9	78.8	80.4	82.0	79.0	75.9	67.5	57.0	69.6	109	34
Mishmar Haemek	44	32°38'	35° 8'	- -	4	54.5	54.5	55.9	64.2	69.4	74.8	78.8	80.1	77.4	74.7	66.2	57.9	67.4	110	36
Nahalal	45	32°42'	35°12'	328'	3	56.1	57.6	59.0	64.9	70.7	74.8	78.6	79.3	76.5	73.9	61.7	59.5	67.7	104	36
PLAIN OF ACRE (Emeq Zevulun)																				
Acre	46	32°55'	35° 5'	61'	12	56.0	56.0	59.0	64.0	69.0	73.0	80.0	81.0	77.0	73.0	68.0	59.0	70.0	110	34
Kefar Massaryk	47	32°53'	35° 6'	- -	3	55.9	56.3	58.3	62.4	66.9	63.1	75.7	76.5	76.1	77.0	65.1	58.5	66.0	105	40
Nahariya	48	33°	35° 5'	- -	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-
Usha	49	32°47'	35° 7'	- -	5	57.0	59.7	61.0	68.7	74.8	79.7	82.4	80.2	80.0	77.2	71.1	61.5	71.1	99	40
LOWER GALILEE																				
Kefar Tavor	50	32°41'	35°26'	- -	-	52.0	54.1	57.7	64.8	71.4	78.4	77.9	81.3	76.2	74.8	66.7	57.0	67.7	- -	-
Mitzpa	51	32°49'	35°31'	164'	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-
Nazareth	52	32°42'	35°17'	1608'	15	49.0	54.0	56.0	63.0	68.0	74.0	78.0	79.0	77.0	75.0	65.0	54.0	66.0	111	25
UPPER GALILEE (Including Plain of Hula)																				
Ajeleth Hashahar	53	33°	35°35'	361'	3	52.9	55.0	57.6	65.1	75.2	79.5	81.0	80.8	80.8	75.0	65.7	65.5	69.5	106	37
Dan	54	33°15'	35°38'	492'	6	51.3	54.9	58.1	64.9	72.7	79.2	80.5	81.1	78.4	74.7	64.6	55.2	68.0	93	35
Eilon	55	33° 4'	35°14'	- -	5	52.3	54.9	56.7	63.9	69.8	73.4	75.7	75.5	75.2	72.1	65.8	56.7	66.0	102	38
Hanita	56	33° 7'	35°10'	1115'	6	53.6	54.1	57.0	63.5	68.7	72.3	74.8	75.4	74.5	72.9	64.4	58.1	65.8	94	40
Kefar Giladi	57	33°15'	35°35'	1050'	7	48.0	51.6	55.9	62.6	70.3	72.9	77.0	77.7	76.3	72.3	63.3	52.7	65.1	86	37
Metulla	58	33°18'	35°36'	1640'	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-
Rosh Pinna	59	32°58'	35°32'	1312'	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-
Safad	60	32°58'	35°30'	2625'	1	48.0	48.0	56.0	60.6	76.6	79.0	76.0	79.0	75.0	69.0	65.0	50.0	65.0	102	37
Yesud Hamaala	61	33° 3'	35°37'	16'	8	51.6	53.1	57.0	64.2	72.9	75.0	79.9	80.8	77.5	73.6	64.2	55.2	66.7	104	37
VALLEY OF JORDAN (Including Valley of Beisan and Plain of Jericho)																				
Beisan	62	32°30'	35°30'	-387'	10	56.0	58.0	63.0	69.0	76.0	81.0	83.0	87.0	82.0	79.0	70.0	59.0	72.0	118	31
Deganiya	63	32°41'	35°34	-649	7	56.1	58.5	62.2	69.6	76.6	82.4	85.3	86.4	82.2	79.3	68.7	60.1	72.3	110	40
Genossar	64	32°50'	35°32'	- -	1	- -	57.6	61.3	69.1	73.9	83.5	84.7	84.4	- -	- -	- -	- -	- -	- -	-
Jericho	65	31°51'	35°27'	-820'	13	57.0	59.0	65.0	72.0	80.0	85.0	88.0	88.0	85.0	80.0	71.0	60.0	74.0	120	36
Kallia	66	31°46'	35°30'	- -	2	59.4	59.4	64.2	69.3	79.2	84.2	87.4	87.6	84.2	83.1	73.9	55.8	74.0	113	43
Kefar Ruppin	67	32°28'	35°33'	- -	1	54.3	57.7	- -	- -	- -	83.1	84.4	85.3	84.6	80.1	69.6	61.2	- -	115	37
Kinneret	68	32°42'	35°33'	-624'	7	56.1	57.6	61.5	69.6	76.8	83.8	86.7	86.4	83.3	80.1	69.3	60.3	72.6	111	41
Menahamiya (Milhamia)	69	32°40'	35°33'	771'	10	55.0	58.0	62.0	69.0	78.0	83.0	87.0	89.0	84.0	78.0	67.0	59.0	72.0	- -	-
North End of Dead Sea	70	31°49'	35°30'	-1260'	4	58.0	60.0	67.0	75.0	81.0	86.0	88.0	88.0	84.0	79.0	69.0	61.0	75.0	116	36
Tiberias	71	32°47'	35°32'	-653'	15	56.0	58.0	63.0	69.0	77.0	84.0	87.0	88.0	84.0	80.0	70.0	61.0	73.0	114	34
Tirat Tsevi	72	32°26'	35°22'	604'	7	53.4	54.1	57.7	68.9	76.1	82.6	86.2	88.2	83.1	77.0	65.3	56.7	70.7	114	36

METEOROLOGICAL STATIONS	Years Record	AVERAGE PRECIPITATION (In inches)													Precipitation Effectivity Index	Years Record	RELATIVE HUMIDITY (In %)												
		Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly			Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly
PLAIN OF ESDRAELON and VALLEY OF JEZREEL																													
Afula	2	10.5	2.2	1.5	0.2	0.3	0.0	0.0	0.0	0.0	0.1	0.0	3.5	18.3	38.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beit Alfa	15	4.4	4.3	0.8	0.9	0.2	0.0	0.0	0.0	0.0	0.4	1.6	3.0	15.6	27.4	1	73	66	62	59	61	46	53	56	46	45	49	59	55
Ein Harod	16	4.7	3.6	1.3	0.8	0.2	0.0	0.0	0.0	0.0	0.9	2.1	4.5	18.7	33.5	3	74	75	71	76	67	69	72	77	67	62	65	70	71
Gingar	10	6.3	5.9	1.2	0.9	0.5	0.0	0.0	0.0	0.1	0.6	4.1	5.0	24.6	47.0	4	-	-	-	-	-	-	-	-	-	-	-	-	-
Merhavya	17	5.5	4.3	1.1	0.8	0.4	0.0	0.0	0.0	0.2	1.1	2.3	4.1	19.8	35.4	1	69	84	64	60	47	58	73	64	58	54	55	61	62
Mishmar Haemek	10	5.9	1.2	0.5	0.8	0.0	0.0	0.0	0.0	0.0	1.2	4.4	6.8	20.8	37.6	4	83	80	77	79	71	75	76	78	80	77	79	77	75
Nahalal	17	5.8	7.5	1.2	0.9	0.4	0.3	0.0	0.0	0.2	0.7	4.6	6.7	21.6	51.5	3	-	-	-	-	-	-	-	-	-	-	-	-	-
PLAIN OF ACRE (Emeq Zevulun)																													
Acre	12	5.5	7.9	0.9	0.7	0.2	0.0	0.0	0.0	0.2	1.3	4.1	3.7	24.5	43.4	10	72	77	66	67	66	70	74	73	68	62	65	70	70
Kefar Massaryk	3	7.6	2.1	2.4	0.9	0.2	0.0	0.0	0.0	0.2	1.2	1.3	3.3	19.2	34.0	-	55	57	60	58	76	74	75	80	68	61	56	61	65
Nahariya	1	11.8	5.1	3.7	0.7	0.6	0.0	0.0	0.0	0.0	7.4	6.2	2.1	38.0	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Usha	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LOWER GALILEE																													
Kefar Tavor	5	4.2	4.3	0.7	0.6	0.2	0.0	0.0	0.0	0.0	0.4	4.6	4.7	24.7	36.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mitzpa	12	5.0	4.3	1.2	0.6	2.2	0.0	0.0	0.0	0.1	1.5	2.4	4.5	24.4	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nazareth	15	6.3	4.6	3.7	1.0	0.2	0.0	0.0	0.0	0.0	0.8	3.4	7.1	27.1	54.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UPPER GALILEE (Including Plain of Hula)																													
Ajeleth Hashahar	18	4.9	4.8	1.5	1.1	0.7	0.8	0.0	0.0	0.4	0.4	1.9	3.8	20.3	35.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dan	1	13.3	2.6	2.1	0.8	0.4	0.0	0.0	0.0	0.0	0.2	0.0	2.9	22.3	47.5	3	63	73	73	73	65	64	61	69	72	72	65	70	70
Eilon	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	1	71	70	71	70	67	71	78	78	73	64	54	75	70
Hanita	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kefar Giladi	17	4.0	9.1	2.1	1.9	0.8	0.2	0.0	0.0	0.7	0.8	3.0	6.3	28.9	57.8	2	87	95	85	83	67	83	-	89	-	-	-	94	-
Metulla	11	7.6	9.4	3.2	1.9	0.5	0.3	0.0	0.0	0.0	0.9	2.5	6.8	33.3	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rosh Pinna	11	6.8	5.5	2.8	1.5	0.8	0.1	0.0	0.0	0.9	1.6	3.6	5.0	28.7	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Safad	16	8.1	8.7	1.8	2.8	0.9	2.6	0.0	0.0	0.1	1.6	3.5	6.0	36.1	76.0	1	82	78	74	69	64	-	-	-	67	65	72	71	-
Yesud Hamaala	8	3.9	3.8	1.0	1.1	0.4	0.0	0.0	0.0	0.0	0.6	3.1	4.4	18.3	33.9	7	78	76	72	68	66	67	69	73	73	70	70	75	72
VALLEY OF JORDAN (Including Valley of Beisan and Plain of Jericho)																													
Beisan	10	3.1	2.8	0.7	0.4	0.2	0.0	0.0	0.0	0.0	0.7	1.2	1.4	10.5	16.6	9	73	76	68	58	58	56	55	55	59	53	66	54	60
Deganiya	19	3.5	3.7	1.3	0.7	0.7	0.2	0.0	0.0	0.1	0.6	1.7	4.6	17.1	28.0	1	74	75	66	58	60	59	63	65	62	49	63	68	64
Genossar	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jericho	13	1.3	1.3	0.2	0.4	0.1	0.0	0.0	0.0	0.0	0.1	0.4	1.2	5.0	7.1	13	70	68	56	48	43	44	45	46	52	54	59	66	[illegible]
Kallia	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	-	57	55	47	-	44	42	45	41	43	47	48	52	-
Kefar Ruppin	-	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	[illegible]	[illegible]	[illegible]	-	-	-	70	77	72	65	63	73	77	-
Kinneret	9	4.1	3.5	1.6	5.4	0.2	0.1	0.0	0.0	0.0	0.4	1.6	4.2	21.1	34.6	7	74	78	70	63	57	61	63	67	63	61	65	72	66
Menahamiya (Milhamia)	10	3.6	3.8	4.0	2.8	0.7	0.2	0.0	0.0	0.0	0.0	0.2	2.1	17.3	28.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
North End of Dead Sea	4	0.6	0.4	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.4	0.1	0.4	1.9	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tiberias	15	4.7	3.2	2.6	1.1	0.2	0.0	0.0	0.0	0.1	0.8	2.9	5.1	20.2	34.2	9	70	67	63	58	50	46	50	52	50	49	60	68	57
Tirat Tsevi	4	4.3	2.3	2.1	0.6	0.4	0.0	0.0	0.0	0.0	1.2	1.4	1.8	14.1	24.5	4	78	79	80	80	71	61	58	64	69	69	66	69	70

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[1] Frost and Snow: Coastal Plain - Frost and snow almost unknown, The Hill and Mountain Country - Occasional slight frost and snow not infrequent, The Jordan Valley - Frost and snow entirely unknown.

AGRO-CLIMATIC CHART OF TRANSJORDAN AND TRANSJORDANIAN CLIMATIC ANALOGUES IN THE UNITED STATES

METEOROLOGICAL STATIONS	Station Reference No.	Latitude	Longitude	Years Record	MEAN TEMPERATURE (In Fahrenheit) Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly	ABSOLUTE TEMPERATURE Abs. Max.	Abs. Min.
Amman (Rabbath Ammon) •	1	31°57'	35°57'	15	48.8	49.1	56.7	60.3	74.3	78.0	77.0	79.8	75.0	70.4	56.2	52.0	64.8	109	21
Buseira	2	30°30'	35°35'	4															
Deir Abu Said	3	32°29'	35°37'	5															
Ein Gev •	4	32°49'	35°39'	3	58.5	56.3	59.9	70.5	74.7	79.5	84.0	83.8	84.0	79.5	67.8	61.9	71.7	- -	-
El Mezar	5	32°28'	35°47'	4															
Es Salt	6	32° 1'	35°44'	5															
[illegible]	7	31°15'	35°50'	4															
Irbid (Arbil)	8	32°38'	35°50'	5															
Ja'fr	9	31°	35°41'	2															
Kefr Awan	10	32°27'	35°38'	4															
Kefrinji	11	32°18'	35°42'	5															
Kefr Sum	12	32°40'	35°45'	4															
Kefr Yuba	13	32°30'	35°47'	4															
Herja	14	32°40'	35°55'	4															
Kitte	15	32°17'	35°50'	4															
Qasr Azraq •	16	32°15'	37° 5'	4	47.0	50.0	59.0	68.0	75.0	82.0	85.0	87.0	76.0	70.0	59.0	50.0	67.0	113	55
Qasr el Burqu •	17	32°30'	38°10'	4	47.0	51.0	56.0	65.0	73.0	78.0	82.0	84.0	76.0	70.0	59.0	50.0	66.0	110	52
Petra	18	30°20'	35°30'	5															
Qalat ez Zerqa	19	32° 5'	36° 5'	4															
Remtha	20	32°38'	36° 8'	5															
[illegible]	21	30°	35°20'	4															
Shobek	22	30°25'	35°35'	5															
Taiyibe	23	32°31'	35°46'	4															

Station Reference No.	AVERAGE PRECIPITATION (In inches) Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly	Precipitation Effectivity Index	TRANSJORDANIAN AGRO-CLIMATIC ANALOGUES IN THE UNITED STATES (Based on analogy of precipitation distribution, amount of precipitation, precipitation effectivity index, and also in most cases temper. conditions. Where the latter is different another area is indicated for temperature analogue.)	Latitude	Altitude
1	2.5	3.3	0.8	0.8	0.1	0.0	0.0	0.0	0.0	0.1	1.3	1.6	10.5	21.2	San Jacinto, Riverside County, S. California. Slightly cooler.	33°52'	1,500'
2	2.8	2.9	1.1	0.9	0.0	0.0	0.0	0.0	0.0	0.9	1.4	3.0	13.0	- -			
3	5.4	5.9	1.5	0.7	0.8	0.0	0.0	0.0	0.0	1.6	2.6	2.6	21.0	- -			
4	5.3	2.2	1.8	0.6	0.1	0.0	0.0	0.0	0.0	0.9	1.1	1.5	13.5	22.0	Corona, Riverside County, S. California. Considerably cooler. Raymondville, Cameron County, S. W. Texas. (Temperature analogue)	33°58' 26°30'	1,049' 31'
5	3.8	2.2	1.5	1.6	0.6	0.0	0.0	0.0	0.0	1.0	1.8	1.2	13.7	- -			
6	8.5	7.4	1.8	1.2	0.6	0.0	0.0	0.0	0.0	2.3	2.6	3.7	22.8	- -			
7	2.7	4.2	1.2	1.3	0.3	0.0	0.0	0.0	0.0	0.7	0.6	1.4	12.4	- -			
8	4.3	4.8	1.5	1.1	0.4	0.0	0.0	0.0	0.0	1.2	2.8	1.5	17.7	- -			
9	0.2	0.1	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.9	2.3	- -			
10	5.1	5.8	1.5	0.7	0.4	0.0	0.0	0.0	0.0	1.5	2.6	2.9	20.5	- -			
11	7.4	7.3	1.8	1.1	0.4	0.0	0.0	0.0	0.0	1.7	2.4	3.1	25.2	- -			
12	5.7	4.3	1.3	1.0	2.7	0.0	0.0	0.0	0.0	1.2	2.4	3.5	22.1	- -			
13	5.5	6.5	1.6	1.4	2.4	0.0	0.0	0.0	0.0	0.9	3.4	2.8	24.5	- -			
14	4.2	4.8	1.2	1.2	0.3	0.0	0.0	0.0	0.0	1.1	3.3	2.5	18.6	- -			
15	6.3	8.7	1.8	1.2	0.4	0.0	0.0	0.0	0.0	1.6	1.4	2.3	23.7	- -			
16	0.6	0.8	0.3	0.3	0.2	0.0	0.0	0.0	0.0	0.1	0.6	0.7	3.5	5.8	Blythe, Riverside County, S. California.	33°35'	268'
17	0.2	0.2	0.5	0.3	0.3	0.0	0.0	0.1	0.0	0.2	0.4	0.6	2.8	3.8	Barstow, San Bernardino Co., S. California.	34°55'	2,105'
18	1.6	1.5	0.8	0.6	0.0	0.0	0.0	0.0	0.0	0.2	1.3	1.1	7.1	- -			
19	1.3	1.9	0.6	0.4	0.2	0.0	0.0	0.0	0.0	0.7	1.2	2.6	8.9	- -			
20	2.0	3.1	0.9	0.6	0.1	0.0	0.0	0.0	0.0	1.1	1.1	1.3	17.3	- -			
21	3.7	0.7	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	6.0	- -			
22	3.2	3.1	0.6	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.3	2.1	10.3	- -			
23	5.6	5.0	1.3	1.1	0.0	0.0	0.0	0.0	0.0	1.2	3.0	2.0	19.2	- -			

* Amman Altitude - 2,548 ft.; Relative Humidity (%) 17 yrs. 74 56 50 63 42 34 39 37 53 45 47 61 50

Ein Gev Altitude - 656 ft.
Qasr Azraq Altitude - 2,624 ft.
Qasr el Burqu Altitude - 2,635 ft.

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